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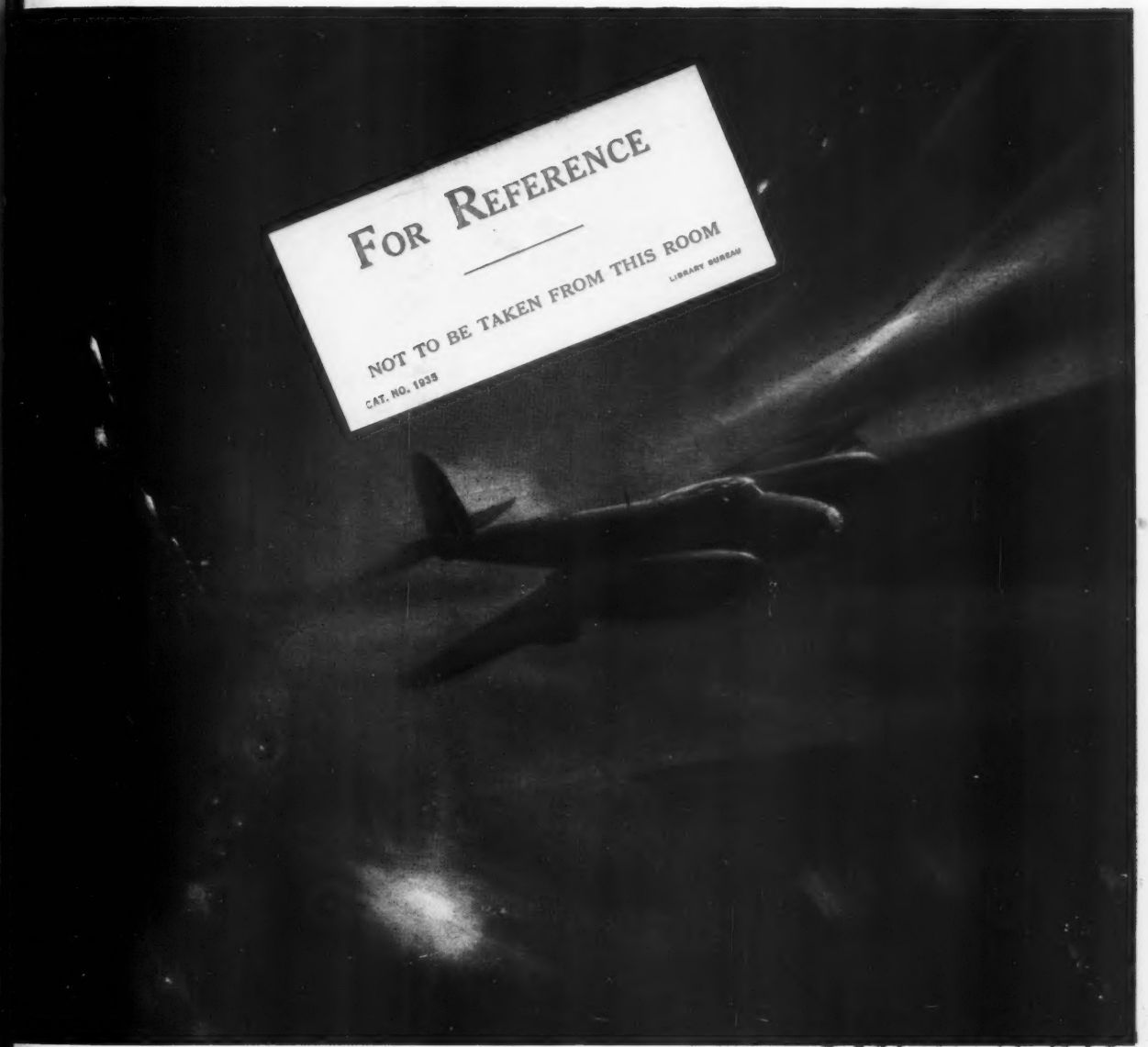

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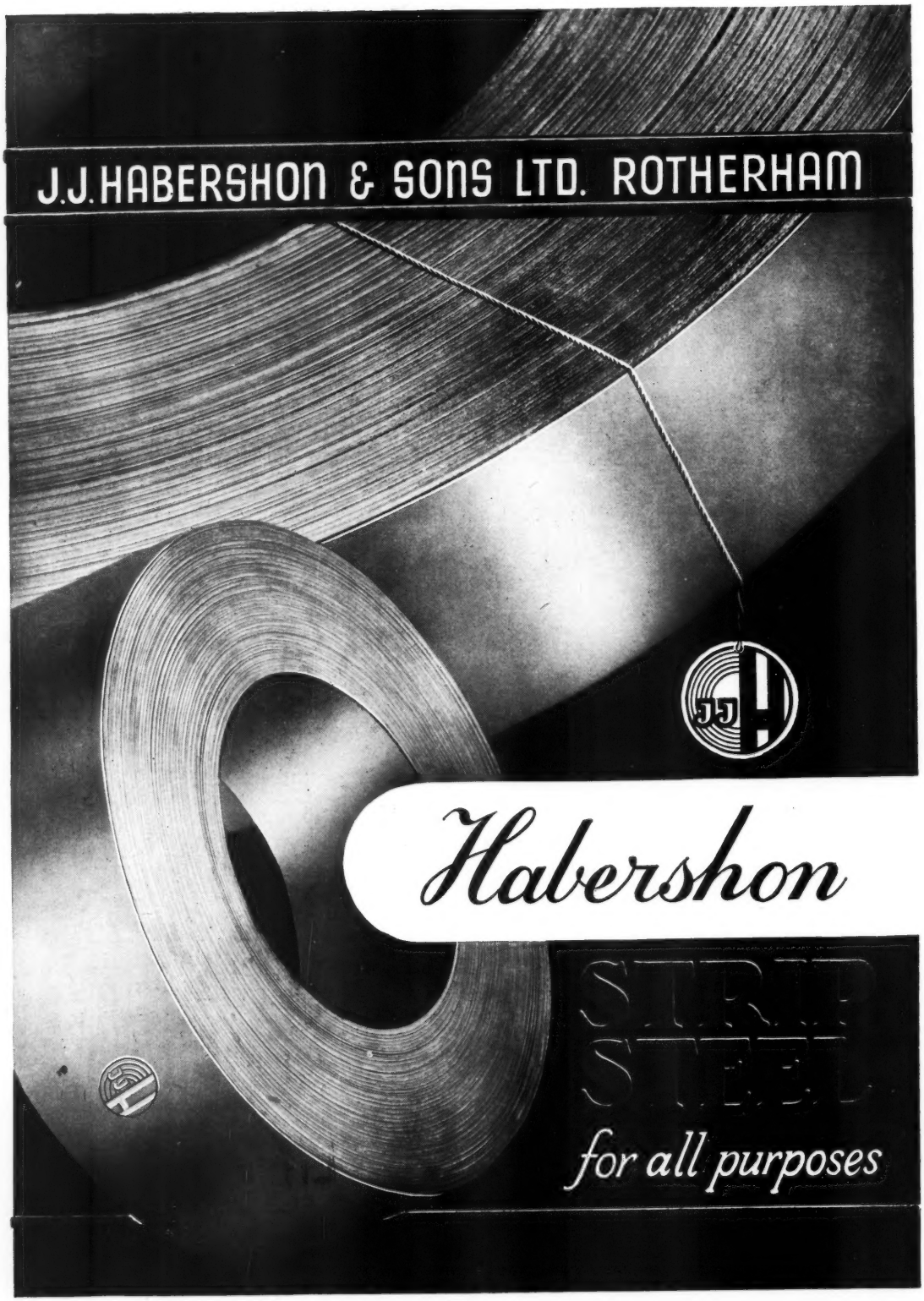
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FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

A Decisive Rôle

FOLLOWING on the Crimea Conference, the Soviet paper *Pravda* foresees the widest opportunities for the close co-ordination of the war efforts of the Allied Powers. Somewhat irrelevantly, it seems to us, the paper adds: "But the actions of Air Forces, however important, will not be able to play a decisive rôle in this."

We have often felt called upon to comment on the absence of air thought in the Russian schemes of war. That is to say that, while the Russians have been using aircraft in great numbers and with excellent results to support their ground forces, they have never shown any comprehension of the value of independent air action. They have, it is true, on occasions bombed German ports and railway centres, and several such raids have been made in the last few days; but the policy of scotching the wasps in their nest has not seemed to appeal to them. This is probably not surprising in a huge land Empire, blessed with enormous masses of man-power. It reminds us of how, in most previous wars, Powers allied to Britain have failed to appreciate the value of the British Navy. Germany started this war in a similar frame of mind as regards air power. The *Luftwaffe* was designed and trained to help the German Army; and when it was forced to attempt independent action in the Battle of Britain it showed itself utterly inept at such work. In fact, Britain was originally the only Power which showed itself alive to the possibilities of independent air action—though the United States (a Power which has not a separate Air Force) was prompt to grasp the significance of British strategic bombing and to develop its own Army Air Forces to share in the work.

The Russians were undoubtedly disappointed that for some long time the British and Americans were unable to attack Western Germany by land, and they made no secret of their feeling that the bomber offensive was not an adequate substitute. At the moment when *Pravda* published this article floods were slowing down the Anglo-American progress towards the Rhine, while the bombers of the western Allies were attacking the German rear in the East and South. *Pravda* may have wished to remind the Anglo-Saxon Allies that progress on land is the only way to beat Germany to her knees.

We do not believe that our commanders are not in accord with this strategy. None the less, the air blows at the Berlin railway centre must help the Russian armies, and recently the air raids from Italy on targets round Vienna must smooth the path of Marshal Koniev's southern armies. The air offensive from the West and South has in the last week grown to unprecedented proportions, and the whole transport system of Germany has suffered. From this both East and West Fronts cannot but benefit. Mr. Churchill and President Roosevelt have never even hinted that they expect Air Forces to play a decisive rôle. Combined operations are their method, and in them the air plays an indispensable part.

Adolf's Nest

IT was surely some spirit of mischief which inspired the responsible officer of the Mediterranean Allied Air Forces to send out some Thunderbolts with Berchtesgaden, near Salzburg, as their alternative target. Very possibly the formation leader was not very sorry when he could not find his primary target, but did manage to identify the little village in the Bavarian Alps near which Hitler has his private hideout. It has never been thought worth while to make the place a primary target, but the American pilots probably thought it a lark to drop some bombs on the place. They did not try for the Führer's house, and only attacked the station, where they did a certain amount of damage.

It will probably be impossible to hide the incident from the German people, and they will surely look on it as sacrilege. At the very least, it would seem to them an act of disrespect towards a being whom for years they have almost worshipped as sacrosanct. And, it has happened just at a moment when the sacred soil of East Prussia is in the hands of the Russians, when the Oder no longer defends Berlin, and when from every direction defeat stares the German people in the face.

The Next Chapter

QUIETLY, without fuss, and without the country at large being aware of it, the curtain was lifted for a brief moment at the Royal Aeronautical Society to give one a glimpse of the dazzling future of flying. The occasion was the reading of a paper before the R.Ae.S. by Air Commodore F. R. Banks last week.

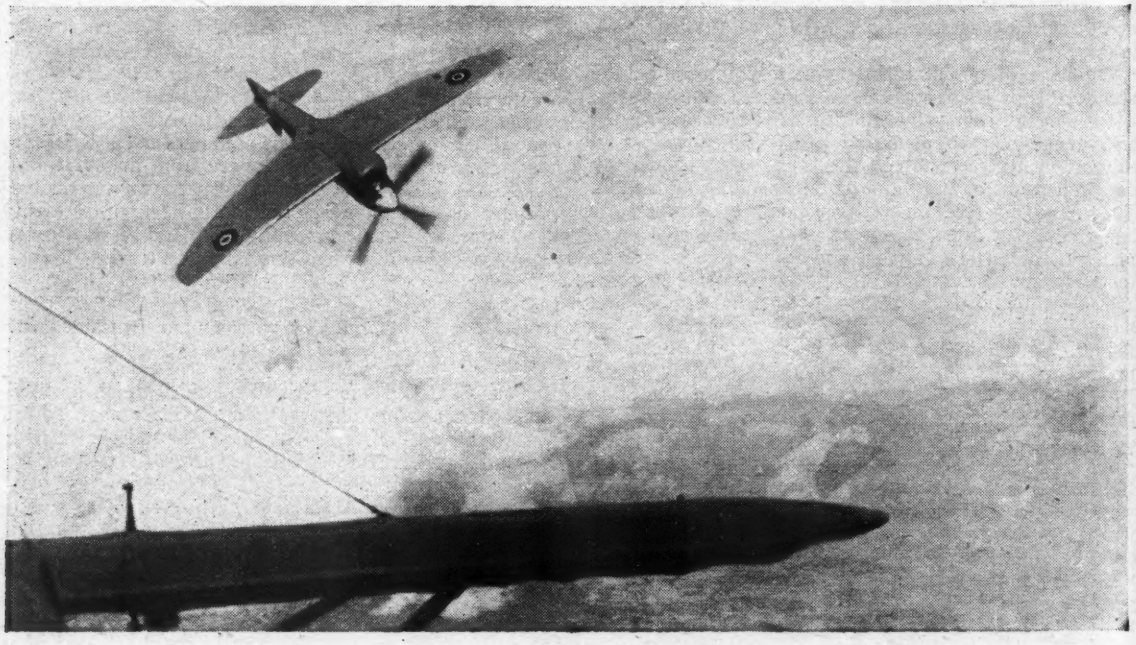
There were those who thought the lecture itself disappointing in that Air Commodore Banks did not give more than a minute fraction of the information which he has. That was inevitable. Security considerations necessarily confined him to generalities. And the discussion had perforce to follow the same general character. But in spite of this enough was said to show that a new and intensely interesting chapter is about to be unfolded.

Air Commodore Whittle has opened the door for a further pressing-back of the limits on speed and height. The task is not without its serious problems, but we can begin to see where we are going. Dr. Ricardo used the expression: "On some such lines it should be possible to realise an overall efficiency far in advance of anything which has yet been achieved or is in sight with either the piston engine or the turbine alone." The "lines" referred to the combination of the two-stroke piston engine, possibly of diesel type, with the gas turbine, as suggested by Air Commodore Banks.

That statement ("efficiency far in advance," etc.) is sufficiently startling in itself, but when taken in conjunction with other statements, made by the lecturer and by those taking part in the discussion, it promises a future which almost baffles the imagination. For piston engines a specific consumption of 0.40 or even 0.38 lb. per horse-power per hour was foreseen. So the two-stroke/turbine combination is promised to do better than that. Jet efficiency follows a linear law, so that for every aerodynamic improvement in the airframe, giving greater speed, the thrust horse-power of the jet engine is automatically increased (because with constant thrust the power developed is thrust multiplied by speed). Thus the incentive to clean aircraft design becomes more powerful than it has ever been. The reward is likely to be so much greater. If, therefore, very high speeds can be coupled with fuel-consumption efficiencies greater than any hitherto visualised, the economical aspect of long-distance air travel will change completely. So far as we can see the two most difficult problems, apart from those directly connected with the necessary power-plant development, will be how to get through what Air Commodore Banks termed the "compressibility wall," and that of providing a pressurised cabin for the passengers. Doubtless, however, these will be solved in time.

CONTENTS

The Outlook	217
War in the Air	219
Here and There	222
The D.R. Compass	224
Power Unit Development	226
British Carriers in the Pacific	228, a & b
Hawker Tempest V	229
Commercial Aviation	235
Correspondence	237
Service Aviation	238



ROLLING OUT THE BARREL: A Napier Sabre-engined Tempest V demonstrates its high-speed rolling characteristics above the clouds. This latest Hawker fighter has been very successful against German jet propelled types and did splendid work against the flying bomb. A full description of the Tempest V appears on pages 229-234.

HARD HITTING AT HONG KONG: Carrier-borne aircraft of a U.S. Navy task force drop bombs on Taikoo dockyard where Japanese vessels are repaired and refitted. The bomb on the left set on fire a 4,500-ton transport. On the right is seen the smoke from a direct hit on a machine shop.

WAR in the AIR

Record Air Attack on German Transport : Russians Also Bomb Railways : A Brush with E-boats

LAST week Nuremburg was the place which received most attention from British and American heavy bombers. The railway station there was found to be packed to capacity with trains and waggons, and one may imagine for oneself the havoc wrought among them by the heavy bombs and fire-bombs which rained down from above. As usual, a series of raids by day and night was sent against the place until it was felt that there was not very much more that a bomb could do for the time being.

The papers in this country have lately been publishing photographs of fields of snowdrops and crocuses, which indicate that springlike weather has come, and not only to the Straits of Dover. The 2nd Tactical Air Force had been grounded for four days when the spell of fine weather reached the Low Countries. Its 83rd and 84th Groups burst into immediate life and activity, and the activity was intense. The floods which the Germans had produced by partially demolishing dams which were in their hands began to subside about the same time. The Allied advance continued, and it was still heavy going ; but it begins to look as if the worst of the discomforts of winter are over for our men. In finer weather and on drier ground they will be able to drive the Boche before them at an improved rate.

One is apt to forget the constant watchfulness which Coastal Command must always maintain, not only in searching for U-boats in the Western Approaches and elsewhere, but in guarding against sudden raids by E-boats on Allied shipping making its way to and fro between Britain and Antwerp. It must be a monotonous job, for naturally the E-boats do not come out every night, and they would certainly not do so when there were obvious signs that Allied aircraft were on the *qui vive*. But one night last week there was a cheerful little brush off the Dutch coast, when the E-boats came out in strength. Wellingtons

HOME FROM YALTA : Air Commodore Churchill enters "Number Ten" on his return from the three-power conference. He travelled by air

WAR IN THE AIR

based in Britain and naval Swordfish from a base in Belgium tackled them. One Wellington bombed five of the boats which were proceeding at 10 knots, and saw four explosions, followed by a cloud of smoke. Another Wellington bombed six stationary auxiliaries of the trawler type. At the same time a constant duel is kept up between Coastal Halifaxes and German shipping in the Skagerrack. Rocket-firing Mosquitoes likewise search the Norwegian fiords, and every now and then find a merchantman which provides a worthy target.

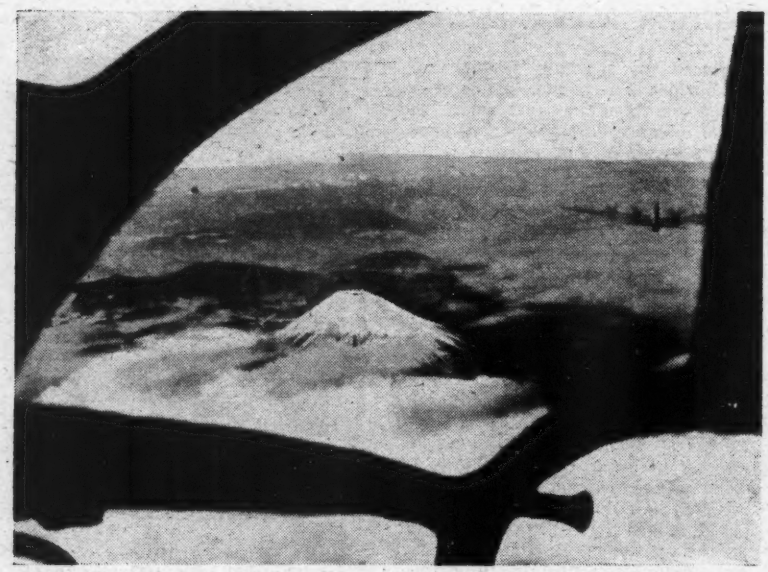
Aircraft and Russia

LAST week the Russians made one of their rare indulgences in bombing behind the enemy's lines, and attacked the railway yards at Stettin, Stargard, and Breslau. The chiefs of the Red Air Fleet may have felt that when the British and American heavy bombers were flying such very long distances to upset the rear of the German armies facing the Russians, it would only be decent for Red bombers to join in the fun. All such co-operation is to be welcomed. Future historians may decide that the Russians, who for years bore the brunt of the land war, were well advised to develop to the utmost the art of using the air to help their ground troops; and to leave strategic bombing to Britain, which for so long was not able to fight on land, except south of the Alps. But it is good to see East and West working in unison.

Reports from Berlin say that the successor to Gen. Cherniakovsky in East Prussia is making tremendous use of tactical aircraft, and that south of Königsberg there are seldom fewer than 2,000 Russian aircraft in the sky. The Germans cannot put up anything like equal numbers, and their ground troops must suffer accordingly. Their staff must be left in almost complete ignorance of the movements of the Russian forces, and if aircraft never dropped a bomb or fired a rocket, but could still make the difference between knowledge and ignorance of the enemy's movements, they would still amply justify their existence.

"ON THE ROAD TO MANDALAY"; The flying fishes in this case are R.A.F. Liberators of the Strategic Air Force, Eastern Command. They made a daylight attack on the supply base at Armapura.

When your enemy reels, hit him harder. That is a good maxim for the prize ring, and also for war. The *Wehrmacht* is tottering, and so the Air Forces of Britain and the United States have worked up the weight of their blows to a degree never before seen or contemplated. Thursday, Feb. 22nd, saw the start of a new stupendous effort, such as the Allies had never made before. The railway system of Germany was the chief objective, and the bombers struck at second-class lines as well as the main lines. The latter had already suffered severely, and much traffic had been diverted to side-lines. The U.S. Strategic Air Forces in Europe sent out more than 3,000 aircraft, some from Britain and some from Italy. Bomber Command co-operated heartily. The Americans, after crossing the areas where the heaviest *flak* was to be expected, split up into small groups of 35 to 70 machines, so as to distribute their attentions as widely as possible. The day and night must have been a very unpleasant 24 hours for Germany. The fine springlike weather permitted visual aiming by day, and reminded the Germans that winter is nearly over and that still worse can be expected as the weather improves. One would like to know how many German commanders waited vainly for trains of supplies and reinforcements which never arrived. However full the stores depots may be (and they must be getting somewhat depleted by this time) it is a poor consolation for the fighting soldier to be told that there is plenty of ammunition in stock, if trains cannot bring it to him when he is running short.



SPOTS FOR THE RISING SUN: Super-Fortresses, on their way to bomb Tokio, fly over Mount Fuji.

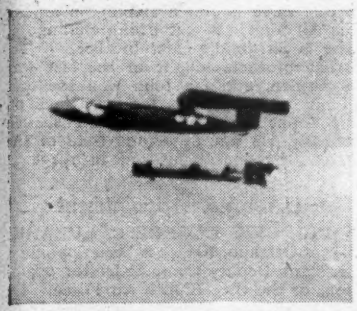
The Japan War

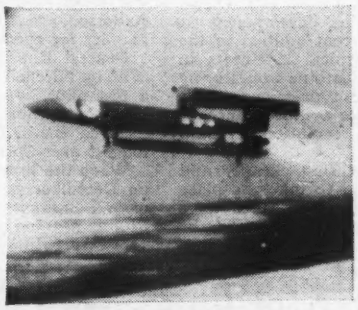
WHEN there is a particularly tough bit of invasion work to do, the Americans give it to their Marines. It is Marines who have landed on Iwojima, and they seem to have run into the toughest land fighting that American troops have yet encountered in their war with the Japanese. Casualties on both sides have been heavy.

What is more, the danger which Japan would suffer (and doubtless will

suffer) from the American occupation of that island has stirred the Japanese Air Force into activity. For some time past it has not shown much stomach for a fight. But last week a force of Japanese aircraft forced its way through the protection of fighters and A.A. fire round the supporting U.S. fleet, and did some damage to American warships. Admiral Nimitz has admitted so much, but so far has not published details. Seven enemy aircraft were destroyed, which does not seem a very satisfactory number.

But too much should not be made of occasional set-backs. The Americans have established naval superiority in the seas round Japan, and are using their superior Air Forces to exploit





AXIS BOOMERANG: Four views of the American - produced flying-bomb taking off. In the bottom photograph the bomb is shown on its trolley at the end of the launching ramp while in the next illustration smoke can be seen coming from the rocket carriage which gives the initial urge for take-off. The first photograph of the bomb in the air shows it still being propelled by the launching rockets. In the top picture the launching carriage can be seen falling away as the speed of the flying bomb exceeds that of the rocket carriage. Our Allies cannot be blamed if they use this weapon which was devised by the Axis.

that naval advantage. It has been stated that there are a quarter of a million Japanese troops isolated on various Pacific islands. With command of the sea lost, they have no hope of rescue; and they all get bombed in turn at frequent intervals.

Photographs have shown that a large area of Tokyo has been devastated by fire. The majority of the city consists of wooden buildings, through which fire would quickly spread. It has been pointed out, though, that the people of Tokyo have suffered so often from earthquakes that they are less likely than most other townsmen to be upset by attacks from the air.

Gen. Eisenhower has given an interview to the Press in which he said that his object was to destroy all the German forces between the Allies and the Rhine. It is, in truth, the destruction of the German forces, rather than the occupation of any city or tract of territory, which will bring final victory. The General reminded his hearers that a river is never an

WAR IN THE AIR

impassable protection to any country.

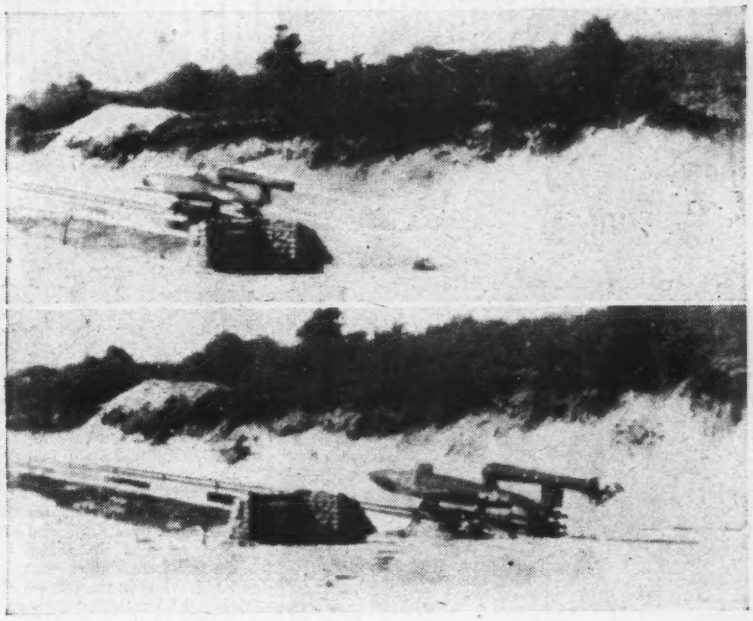
Meantime, the attack in the West goes well, though the troops must still be having a hard and uncomfortable time. It is claimed that the Allied Air Forces have practically isolated the battle, and prevented the Germans from moving up reinforcements or staging serious counter-attacks. It is not often that Air Forces can succeed in doing that, and during the campaign in Africa the Air Staff warned British observers not to expect it. But now the German commentators are speaking of "Montgomery's almost absolute domination of the air," and say that that, added to the weight of the Allied artillery, is keeping the Germans pinned under cover and almost blind. Incidentally, the Supreme Commander explained why the U.S. 9th Army had been put under Field Marshal Montgomery for this battle. At the same time the U.S. 29th Tactical Air Force has been placed under the command of Air Marshal Coningham.

The *Luftwaffe* has ventured into the air on occasions during the battle in the West. Last Sunday seven Tempests fought 15 Me 109s, which were said to be very well handled by their pilots; but the British fighters shot down four of them without loss to themselves. Next day 12 Canadian Spitfires attacked 40 Messerschmitts and shot down seven. Jet-propelled German fighters appear here and there, but for the most part they do not seem anxious to engage in dog-fights.

Turkey and Egypt have now declared war on Germany. It is tragic that at this juncture the Premier of Egypt should have been assassinated. The declaration of war by Turkey should be of material assistance to Britain in clearing the remnants of German garrisons out of the Ægean Sea. The neutrality of Turkey was a handicap to the operations of the R.A.F. Middle East Command.

Internees Rescued

YET another use has been found for parachute troops. There was an internment camp at Los Banos, 30 miles to the south of Manila, mainly occupied by American citizens, but also including 300 Britons as well as some men from the Dominions and Allied countries. There was a Japanese garrison of 243 officers and men. For several nights Filipino guerilla troops wormed their way through the enemy's lines, and then an American airborne division crossed a lake near the camp in amphibious craft. Finally a detachment of a parachute regiment took off from Manila and dropped inside the camp. The Japanese guard was found at morning exercises and was completely surprised. It was quickly overpowered, and the internees were set at liberty. They were found to be suffering from undernourishment, but to be in better condition than those previously rescued from Manila.



HERE AND THERE

Roll Out the Barrels!

THE U.S. Petroleum Administration for War has called upon the American oil industry to increase its production rate to 5,118,760 barrels daily during the present month. The daily output of all petroleum liquids during February was 5,074,850 barrels.

Black Widow's Armament

ARMAMENT details of the Northrop P-61 Black Widow twin-engined night-fighter were officially disclosed in Los Angeles last week.

The power-operated turret above and behind the pilot's cockpit mounts four 0.5in. machine-guns, and there are four 20 mm. fixed, forward-firing cannon in the underbelly.

Expansion of French Air Force

THE French Air Force is to have more than 600 aircraft and a personnel of 4,000 men. This was stated by their Air Minister, M. Charles Tillon, when he recently spoke to workers at a Paris aircraft factory.

"Its fire power," added M. Tillon, "will be greater than that of the 1940 French Air Force."

The workers presented him with the 100th aircraft built in France since the liberation, and M. Tillon said he would put it at the service of the French forces fighting on the Atlantic coast.

On Behalf of F. D. R.

THE U.S. "Legion of Merit, Degree of Commander," was presented last week to Air Chief Marshal Sir Frederick Bowhill by Brig. Gen. Earl S. Hoag, Commanding General, European Div. U.S.A.A.F. Air Transport Command, on behalf of the President of the United States.

Sir Frederick, who is retiring, is to be succeeded by Air Vice-Marshal Sir Ralph Cochrane as C.-in-C. R.A.F. Transport Command; Sir Ralph will take up his duties with the acting rank of Air Marshal.

The presentation to Sir Frederick Bowhill was made in the European Div. headquarters before staff members of the two commands "for exceptionally meritorious conduct in the performance of outstanding services to the Air Transport Command from January 14th, 1943, to September 30th, 1944."

Awards to Ex-A.T.C. Cadets

THE names of nine former A.T.C. cadets who have won decorations for gallantry in operations appear in a list of R.A.F. awards published last week. Two flying officers get the D.F.C., and seven flight sergeants the D.F.M.

They joined the R.A.F. from A.T.C. squadrons in South Wales, Kent, Essex, Devon, Lancashire, Co. Durham and Staffordshire.

Engine of the Future

AIR COMDRE. F. R. BANKS, director of engine development at M.A.P., said in a recent address to the Institution of Mechanical Engineers in London that the gas turbine would bring about a change in the type of power unit which would influence aviation much as the steam turbine revolutionised ship propulsion.

The gas turbine, using cheaper and safer fuel, was bound to take the place of the piston engine, and its smoothness would mean less maintenance for the aircraft. It was hoped, he added, soon to get 1,000 hr. between overhauls; that might take another year or two, but it could be done.

Sir John Tremayne

A NEW name appears among the list of British Air Marshals; it is that of Sir John Tremayne Tremayne, who was, until recently, Sir John Tremayne Babington.

As from January 12th, Sir John has renounced the name of Babington and adopted that of Tremayne, which was his mother's maiden name.

But there is still a Babington among the Air Marshals—Sir Philip Babington, who is Sir John's elder brother.

The brothers fought in the last war as airmen, and Sir John won the first of his several awards for his attack on the Zeppelin sheds at Friedericksshaven in 1914. He was appointed head of the R.A.F. mission to Moscow in 1943.

U.S.A.A.F. Appointment

BRIG. GEN. EUGENE L. EUBANK, of Orlando, Fla., has been appointed Assistant Deputy Commander for operations of the U.S. Eighth Air Force. He will work with Major General Orvil A. Anderson, the Eighth's Deputy Commander for operations.

General Eubank was aide to General William Mitchell for a time and later was a test pilot. In leading the 19th bombardment group to the Philippines he received the D.F.C. for pioneering the longest over-water route yet to be flown.

When the Japs struck at Pearl Harbour on December 7, 1941, he was in charge of all heavy bombardment in the Philippines and earned the Silver Star

AT BUCKINGHAM PALACE: Civil and military aviation, including the aircraft industry, were well represented in the New Year's Honours List this year. Prominent among those who attended a recent investiture held by the King were Sir Arthur F. Sidgreaves, managing director of Rolls-Royce, Ltd., and Mr. R. H. Coverley, controller of Rotol, Ltd., who received the C.B.E. On the left Sir Arthur is seen outside Buckingham Palace with Lady Sidgreaves, after being knighted by the King, while in the picture above is Mr. Coverley, with Mrs. Coverley on his left and his daughter, Mrs. L. King, on his right.

HERE AND THERE

for gallantry in action. For two months General Eubank and his flyers fought the Japs in Java.

Allison Jets

MR. E. B. NEWILL, general manager of the Allison Division of General Motors Corporation, recently announced that they were preparing for the quantity production of jet-propulsion units for the U.S.A.A.F. Actual production may have begun by now.

In order not to interfere with the delivery schedule of the liquid-cooled 12-cylinder Allison V-1710 engine, the plant is being extended at a cost, including tooling and equipment, of $12,500,000.

A large number of sub-contractors have been engaged for the present, presumably until the new construction, which includes seventeen specially designed test cells, is completed and ready for action.

Red General Visits R.A.F.

MAJ. GEN. OF AVIATION SHARAPOV, Deputy Head of the Soviet Military Mission, accompanied by Lt. Col. Roudoi and Maj. Samarin, Assistant Air Attaché, have been touring the R.A.F. and 2nd T.A.F. units on the Continent.

The visitors attended a briefing of crews of Mitchell bombers, and were shown the technical details of medium bomber operations, particularly in instrument bombing.

Phew!

SOME breathless figures about the Merlin engine are given in a recent issue of *Canadian Aviation*. "Some parts of the engine," it says, "rotate at more than 28,000 times per minute, and the gear which rotates at this speed in the supercharger unit makes more than 2,000,000 tooth contacts per minute with three other gears. The outside rim of the supercharger impellors travels at 1,271 ft./sec.; i.e., faster than the speed of a rifle bullet."

Poland Honours Canadian Air Chiefs

AIR MARSHAL ROBERT LECKIE, Chief of the Air Staff, R.C.A.F., and Air Marshal L. S. Breadner, A.O.C.-in-C., R.C.A.F. Overseas, were recently invested with the insignia of the Grand Officers' Cross of the Order of Polinia Restituta by the President of the Polish Government, M. W. Raczkiewicz.

The President thanked the two leaders of the Canadian Air Force for the "outstanding services rendered to Poland by their devoted collaboration with the Polish Air Force."

Weighty War-paint

THE increase in speed and general efficiency of an aircraft resulting from leaving its metal skin unpainted has been commented upon before. A recent example of this is the Martin Mars flying boat.

When the blue-and-white camouflage paint was removed from the Mars, its weight was reduced (according to a recent issue of *The Christian Science Monitor*) by no less than 628 lb. But that was not all.

The reduction in parasite drag raised the speed by 4.3 m.p.h., and on a run to Hawaii a saving of 100 gallons of fuel was effected. And as 100 gal. of fuel weighs 580 lb., the total pay-load increase in this instance totals 1,200 lb.

Going Up!

THREE promotions and two decorations in one week came to P/O. B. D. Walker, A.F.M., of Toronto.

"Monday I was a sergeant, Tuesday a flight sergeant, Wednesday a warrant officer, Thursday morning a pilot officer, Thursday night the commanding officer told me I had the Air Force Medal, Friday I got the 1939-43 Star," the young air-gunner awaiting repatriation to Canada, said on arriving at a R.C.A.F. repatriation depot in Britain.

Latterly he has been serving with a Halifax squadron of the Canadian Bomber Group in Britain, but his documents had apparently been delayed in transit from the Bahamas, where he previously flew in Liberators, so all his promotions came at once.

The A.F.M. was awarded P/O. Walker for devotion to duty while in the Bahamas.

Nice Work, Aussie!

HATS off to Flt. Lt. Leagh Murray, Australian pilot of a P.R. squadron, who, though he cannot shoot down Huns with his unarmed Spitfire, recently scared one to death—literally!

Making his 163rd "op" well into Germany, he broke cloud at 9,000 feet and saw a Ju 88. The normal drill for a P.R. pilot in such circumstances is just to "cram on the coal" and wave good-bye, because an unarmed P.R. job can leave any Ju 88 like an "also ran."

But Murray did no such thing. He flew straight at the Hun and bluffed him into such a tight turn that the Ju 88 went into a high-speed stall. The last Murray saw of his enemy was his spinning into cloud at only 3,000 feet, with about as much chance of pulling out in time as Hitler has of lunching at Buckingham Palace. But he did not actually see him crash, so he was only credited with a "probable."

LADS OF LADD: Four typical Russian Air Force pilots at Ladd Field, Fairbanks (the Alaskan end of the "North West Passage" from Edmonton, Alberta), where lend-lease aircraft are handed over by their American pilots. The Soviet airmen then fly them over the Bering Straits and across Siberia to the Eastern Front.

The D.R. Compass

British Instrument Used by Allied Air Forces to Ensure Required Flying Accuracy

SOME years before the war an instrument was conceived at the Royal Aircraft Establishment, Farnborough, by means of which the several errors and operational variables of normal magnetic compasses could be circumvented.

In 1937 the Air Ministry approached the Automatic Telephone and Electric Co., Ltd., with the request that they should undertake development and mass production of the new device, this being a natural-enough sequel to the company's very valuable experimental work on the radio-controlled Queen Bee aircraft.

Normal types of magnetic compasses such as were fitted in aircraft—and still are, as stand-bys—are prone to two disadvantages: (1) they are susceptible to acceleration and deceleration, and thus will give a steady reading only during steady flight; and (2) they are susceptible to magnetic influence from parts of the aircraft structure and equipment, which, having the effect of screening the earth's magnetic field, makes the compass somewhat inaccurate, despite compensation by permanent magnets. Quite obviously then, there existed an excellent case for improvement in compass efficiency. The Distant Reading Gyro-Magnetic Compass—to give it its full title—was the answer.

In the title lies a direct clue to the operation of the device, for it involves two natural principles, that of the magnetic compass, which always seeks to show the direction of magnetic north; and that of the gyroscope, which, when spinning very fast, possesses great rigidity in space. Gyroscopes are utilised in many aircraft instruments because, owing to their natural function, movement of the aircraft in any of its three planes of motion can be registered against the rigid data of the gyroscopes' spin axes.

Installation

A D.R. Compass installation comprises: (1) a Master Compass Unit which is most usually fitted in the tail of the fuselage where it is remote from armour plating or electrical circuits which might cause local magnetic disturbance; (2) a series of Repeater Compasses for pilot, observer, navigator, bomber, etc.; and (3) a Variation-setting Corrector by means of which local variation up to 30 deg. east or west can be compensated. All the several components located at different stations throughout the aircraft are linked by electrical harness, screened and bonded to preclude interference with radio reception.

The master unit consists essentially of a small, compact gyro element, the two parts of which are arranged as the stator and rotor of a three-phase squirrel-cage motor. This is mounted in gimbals, and rotates at approximately 12,000 r.p.m. about a horizontal axis, and, owing to the rigidity of the gyro in space, any change in the aircraft's course results in a change of angle between the flight line of the machine and the gyro axis. Relative movement between gyro and aircraft is used to govern the rotational direction of an electric motor which, in turn, drives the transmission system for the repeater compasses.

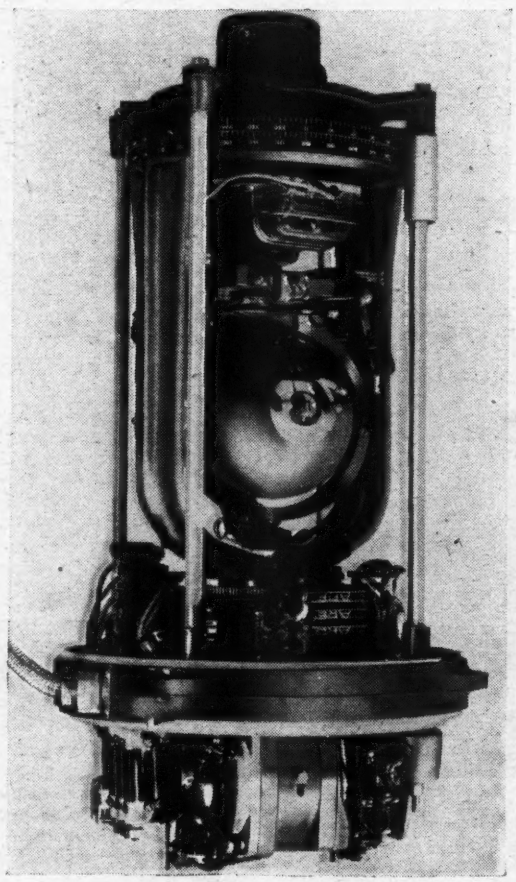
Precessional Control

A magnetic element is located beneath the gyro unit and exercises over the latter a slow rate of precessional control so that the gyro axis is constantly stabilised relative to the obtaining magnetic meridian; thus, as the repeaters indicate relative movement between the gyro axis and the line of flight, they consequently indicate relative movement between line of flight and the local magnetic meridian.

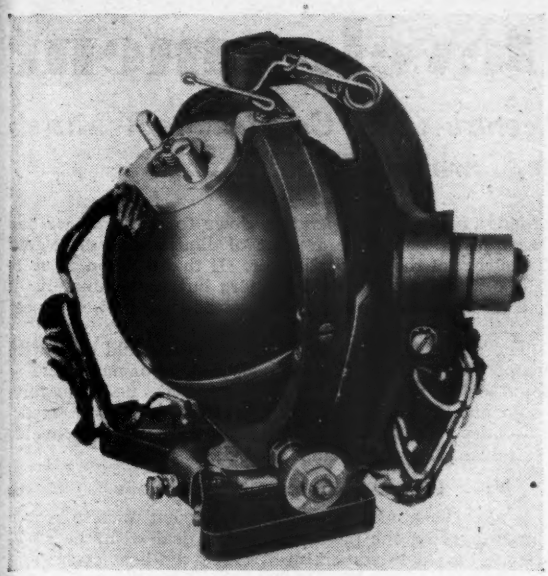
The pilot is, of course, steering his aircraft according to the transmitted indications from the gyro unit, and any alterations of heading he may make are necessarily indicated accurately and immediately, the precessional control exercised by the magnetic element being much too slow to be effective in registering the element's own erratic movement at such a time. Nevertheless, over protracted periods the magnet's government of the gyro is enough to stabilise the latter and prevent its tendency to precess away from the magnetic meridian. It may thus be appreciated that the combination of gyroscope and magnet permit the desirable characteristics of one to offset the caprice of the other.

The earth's magnetic field differs markedly from that of an ordinary magnet. Points of maximum strength are not actually at the magnetic poles but at places adjacent to them; in any case, the positions of the magnetic poles themselves are constantly changing, and, additionally, the magnetic field is not symmetrical, its direction varying continually in relation to the geographical meridian. A magnetic compass, undisturbed, will align itself with the magnetic meridian, and there is always an angular discrepancy between the magnetic and geographic meridians, due to the causes just stated, this discrepancy being called variation.

It is obviously of prime importance to a navigator that he should know what the amount of variation is at any



Master unit with cover removed showing the gyroscope sphere mounted within the rotatabie inner frame. The magnetic unit is seen below the gyro whilst the transmission motor is on top of the frame.



Gyroscopic unit in its gimbal mountings. The cylinder at the right centre is one of two pot magnets which effect precessing control.

particular position; and for this reason lines of constant variation, called isogonals, are marked on all aerial maps, together with the known annual rate of change. Navigators can, therefore, compute what the magnetic variation is at the several positions along the aircraft's path; and, according to whether the variation is easterly or westerly, can add or subtract the requisite amount to obtain the true direction.

Correcting for Variation

An advantage possessed by D.R. installations which places them even farther ahead of normal compasses is that a variation-setting corrector is incorporated between the master unit and the repeaters. In essence, the corrector comprises a repeater motor and a generator by means of which an independent series of impulses is sent to the various repeater compasses. To apply variation it is only necessary for the navigator to set the corrector for the known local variation, and the indications of the repeater throughout the machine then register true instead of magnetic courses

The story of the D.R. compass would by no means be complete without reference to the automatic computing bomb-sight (a further item with which Britain leads the world). It is by no means an exaggeration to state that the computing bomb-sight has done a tremendous amount to revolutionise the technique of visual bombing—and this could not have been achieved without the aid of the D.R. compass.

Naturally enough, the function of the bomb-sight is to compute the exact moment of bomb release in order to ensure a pin-point target strike, and with the exception of five manual settings which are carried out during the run up to the target, it is entirely automatic in action.

Manual settings are for wind speed and direction, terminal velocity of bomb, height of target above sea level, and levelling of the sight. Other factors to be considered are the height and air speed of the aircraft, angle of climb or glide (if necessary) and the course.

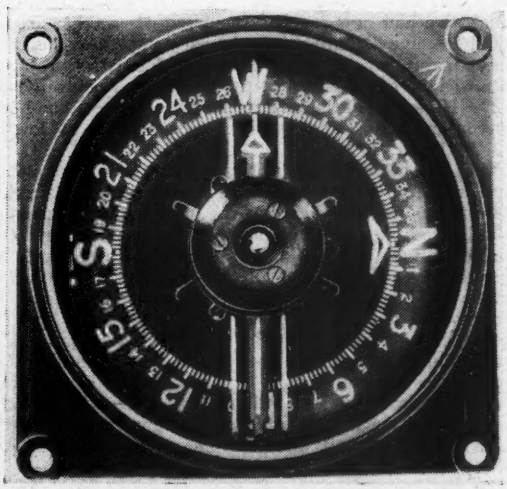
These several factors are determined in the computer and converted into appropriate automatic correction of the sighting head. The course is fed into the computer unit from the D.R. compass which, incidentally, is also employed to control the latest type of automatic pilot as well as certain items of radio equipment still on the secret list.

It is very difficult to assess quantitatively the part played by the distant-reading compass in the air operations

Variation-Setting Corrector by means of which magnetic variation can be integrated out so that repeater indications are True courses

of the Allies—certainly one can say that so much could not have been achieved without it because the discrepancy between the ordinary compass and the scientific aids now given to our aircrews would have been too great.

It cannot be rightly claimed that any one piece of equipment in a modern aircraft allows of this, that or the other being accomplished—it is team work in equipment as well as in men. However, the claim *can* be made, successfully, that the D.R. compass is as great a stride in its own particular field as, for example, the contra-rotating airscrew is in the field of aircraft traction. Probably as good an indication of the instrument's value as any is provided by the fact that not only is it used throughout the R.A.F. and Dominion Air Forces but also by the U.S. Air Forces. Such great raids as those on Augsberg, Berlin and Ploesti, the blowing of the Mohne and Eder dams, the sinking of the Tirpitz, and other numerous attacks—not to mention the amazingly fast long-distance flights of Mosquitos—all these could not have been carried out with such precision and despatch had the D.R. compass not been provided for the navigation. It should be remembered that the evolution and production of the D.R. compass is wholly British.



PILOT'S REPEATER: Rotation of the central knob turns the middle pointer to the desired course and the aircraft is then turned to bring the pointer once more parallel between the grid lines.

Power Unit Development

Turbine-Jet Enthusiasm at R.Ae.S. Lecture : Air Commodore Whittle's Contribution : Piston-engine/Turbine Combinations

LAST week we reported the paper read by Air Comdre. F. R. Banks to the Royal Aeronautical Society under the title, "The Importance of Power Unit Development." The reading of the paper was followed by a very interesting discussion.

Sir Roy Fedden, who was in the chair, recalled the lecturer's long connection with aviation and with fuels and engines, but as this will be well known to most of our readers, and we must reserve as much space as possible for the discussion, we refrain (without offence to Air Comdre. Banks, we hope) from enumerating his many distinguished services here.

DR. H. R. RICARDO (President, Institution of Mechanical Engineers), opening the discussion, said that in view of the rapid development of the gas turbine he felt it was a waste of time and energy to attempt to develop piston engines of the conventional form of over, say, 3,000 h.p.; but that was not to say that he was yet prepared to utter a funeral oration over piston engines in general. The advent of the turbine should and would, he hoped, make the piston engine pull up its socks; and there was still plenty of slack to be taken up, especially in the way of fuel economy.

The fuel consumption of a piston engine was a function of the expansion ratio that we could employ; the power a function of the amount of oxygen that we could stuff into it in a given time. In order to stuff as much oxygen as we could into the cylinder we carried out the compression in several stages, but the expansion in one only, and even that had had to be curtailed. By so doing we outraged the thermodynamic laws and had to pay the price in heavy fuel consumption and the need both for intercooling and for ever higher octane fuels.

Civil Transport Engines

Dr. Ricardo agreed entirely with the author that there was little case for developing special engines for civil transport. He pleaded rather that for civil use we modified the existing highly-developed military engine merely to the extent of increasing its expansion and lowering its first-stage compression ratio. That done, it should be possible, straightaway, to get down to a consumption of 0.40 lb. per shaft horse-power hour, and that on ordinary 100 octane fuel. By so doing we should, of course, lose considerably in take-off power; but to-day we knew of several ways of accentuating temporarily the power of an engine, so that we need not worry overmuch on that account.

Expressing agreement with all that the author had said about the very great advantages of the turbine, Dr. Ricardo joined with him in paying tribute to Air Comdre. Whittle for his masterly pioneering work in that field. The snag about the turbine, of course, was its heavy fuel consumption, and that was rather a fundamental snag. On the other hand, its mechanical efficiency was virtually 100 per cent., which stood it in very good stead, more especially at high altitudes, where the mechanical losses of the piston engine were apt to bulk very large.

The efficiency of any heat engine depended, of course, on the range of temperature through which it could operate. The combustion, in reasonable time, of any hydrocarbon fuel in air gave rise to a temperature ranging from 2,500 deg. to 3,000 deg. C. (absolute), depending on mixture strength, compression ratio, etc. That, then, was the starting point in either the piston engine or the turbine. Unfortunately, the turbine could not digest a temperature much in excess of 1,000 deg. C. (absolute). In order to bring the temperature down to that level we had to supply a very large amount of dilution air, some four times that of the combustion air. If that dilution air were a free issue, it would not matter; but, unfortunately, it had all to be handled and compressed by a blower, whose efficiency was substantially less than 100 per cent.

The piston engine, on the other hand, could cope with temperatures of the order of 2,500 deg. C. or more, and so could drink its working fluid neat, but, unfortunately, could not usefully expand it down to below about 1,500-1,600 deg. C. Thus, the piston engine and the turbine resembled Jack Sprat and his wife!

Piston-Turbine Combinations

Surely the obvious line of development was to marry the two, using the piston engine to deal with the small volume but high-temperature part of the heat cycle, and the turbine with the large-volume low temperature. Between the minimum temperature of discharge from the piston engine and the maximum that the turbine could at present accept there was still a certain gap; to bridge that gap some, but relatively only a little, dilution air would be required. That was a pity in some ways, but we could make a virtue of necessity, for the presence of excess air at once rendered attractive the use both of the two-stroke cycle and of compression ignition. Of the two-stroke cycle because it could deal, with advantage, with a greater volume of air than its cylinder volume defined, hence a much smaller cylinder capacity would suffice; of compression ignition because the presence, in any case, of excess air in the cylinder removed the main handicap to diesel operation, namely, that it was not possible to consume the whole of the air in the combustion chamber.

The experience now available with turbines and blowers of large power brought the application of such a combined unit into the realm of practical politics, more especially for long-range aircraft.

MR. N. E. ROWE (D.T.D.) recalled that the British aircraft engine industry had mastered one particular aspect of development: the art of squeezing the last vestige of power out of each cubic inch of cylinder volume. He thought we had now reached the stage when other aspects should receive attention, such as complete reliability, safety, maintenance, improvement in detail design to cut down weight and, most important, improvements in economy. He was glad the lecturer had referred to 1,000 hours between overhauls and specific consumptions as low as 0.38 lb./b.p.h./hr.

Fuel economy influenced aircraft design in a fundamental way for all types, but particularly for long-range aircraft, where it was the most important parameter in determining overall weight for a given task or specified requirement. The better the fuel economy, the smaller the aircraft for a given duty. He thought all classes of aircraft tended to become too big and heavy for their duties. Insistence on economy did not exonerate the aircraft designer from his part of providing economy in structure and cleanness of form. On the contrary, the latter was of the greatest importance with turbine-jet arrangements because drag, thrust and economy were all implicitly related. Clearly, from now on we must have the closest integration in the design of power unit and airframe, particularly in the earliest stages of the conception of a new project.

The part materials played was important, and knowledge was wanted about the way in which they obtained their qualities and their structure, and how to control it, particularly how to control such fundamentals as moduli of elasticity and rigidity. He thought the search for better

POWER UNIT DEVELOPMENT

materials would help in radiator and oil cooler problems, and he agreed with the lecturer that there was a great field for improvement there.

Mr. Rowe said we were now at the beginning of another period of rapidly-mounting cruising speeds in all classes of aircraft, and hence it was necessary to make every effort to keep wings free of excrescences, especially at the higher values of Mach number. We might, therefore, see many more layouts with engines in the body; this form might lend itself particularly to jet propulsion. This would not necessarily lead to heavier wings, since the wings of long-range aircraft might be filled with fuel to the tips, and that would give relief on structure weight. He did not quite agree with Air Comdre. Banks about the "compressibility wall." He thought a more apt analogy might be that of a craggy hill steepening rapidly from the plain, and more and more boulder-strewn as the climb progressed, with the top in sight but a very difficult path to it.

Ultimate Size

Of the ultimate size in engines, Mr. Rowe said that for military aircraft of 25 tons and upwards, in the medium and long-range classes, the size should be such that there could be no more and no fewer than four airscrew discs or axes of propulsion. But such standards might be swept away with the rate of development now foreseen. In civil aircraft three or four engines might be advisable to ensure a high standard of safety. Much depended on the airscrew, which he thought still had a great future, owing to its flexibility over a wide height and speed range, with either reciprocating or turbine power units. The Mach number would probably be the determining parameter, and he would expect the airscrew to persist even up to speeds of, say, 540 m.p.h. at 35,oooft. in suitable classes. Much attention ought to be concentrated on the elimination of vibration.

AIR COMMODORE WHITTLE said the author had dealt very fairly with the prospects of the gas turbine. He would like to amplify some of the points made and modify the emphasis on others.

The effect of the reduction of temperature with height in improving the efficiency of the gas turbine was not due only to the increase of compression ratio for a given speed. A very important factor was the increase of the positive-negative work-ratio of the constant-pressure cycle for a given maximum combustion temperature. The positive-negative work-ratio was so important that it imposed a limit on the raising of the compression ratio. One could not just obtain more efficiency by raising the compression ratio; there was an optimum figure.

The effect of aircraft drag was even more important with the gas turbine than with the ordinary aircraft engine of the piston type, and especially with the jet propulsion gas turbine, because the thrust horse-power developed with the latter was almost linear with the speed; hence, anything that was done to reduce drag automatically increased engine power. With the petrol engine and airscrew there was a tendency in the opposite direction at very high speeds owing to the falling off of airscrew efficiency.

The author had hinted at the many possible variations in the form of the gas turbine; that was one of the factors which troubled gas turbine designers. To the large number of permutations and combinations possible in the arrangement and type of the main organs must be added the possible variations in the linear scale. In fact, the linear scale of a given arrangement was infinitely variable within wide limits. Those possibilities of variation presented the gas turbine designer with a very difficult problem. In order to fix his design, he *must* know the job of work the engine was going to do.

In Air Commodore Whittle's opinion, the author had over-emphasised the high fuel consumption of the gas turbine; and Dr. Ricardo had also had a crack at it. But that was not an intrinsic characteristic of the gas turbine, if one bore in mind the job of work for which the power plant was intended. Much lower fuel consumptions per T.H.P.-hour than those obtained at present were possible at the price of increased complexity and weight, and whether or not it would pay to go for it depended again on the work the aircraft had to do. For some purposes a simple gas turbine of relatively high fuel consumption, measured in terms of thrust horse-power, could show such a saving in power plant weight that the fuel consumption in proportion to pay-load carried was actually lower than for normal power plant. In illustration of that he mentioned that a well-known aircraft designer, having a very high performance specification to meet, had made rough designs of two alternative aircraft, one with gas turbine/jet propulsion and the other with the normal piston-type power plant; the one with the piston engines had more than twice the weight of the other and had to carry more fuel for the same duration of flight.

Air Commodore Whittle predicted that, even though the gas turbine might never show a fuel consumption as low as the piston engine in terms of thrust horse-power, nevertheless it would be possible to get a greater value of the product of range and percentage of pay-load with the fast gas-turbine-engined aircraft than with the relatively slower piston-engined machine.

GRP. CAPT. P. W. S. BULMAN said the word "development" was used in the early part of the paper five or six times, and each time in a different sense, or one might say in a different tense. The development discussed ranged from the early pre-design development right through the development which the designer wanted while designing the engine; the work that was done in the development department and which showed him why he could not design the engine as he had thought he could; the later work which disposed of the bugs that were in the original design; and right through to the development of the engine to greater powers and greater efficiency. It was well to clarify the word "development," to see where and in what sense it was most usefully employed. In his opinion, and he believed it was the opinion of many experienced engineers, one ounce of development pre-design or in the early design stages was worth thousands of tons in the post-design or early production stages.

In a friendly criticism of the author concerning the jet engine, Grp. Capt. Bulman commented that he had, without much thought, joined the fashionable throng of super-optimists with regard to it. He would not wish to decry the jet as such, and he added that it might be as epoch-making as the rotary engine; but it was, perhaps, as undeveloped!

DR. H. ROXBEE COX, who described himself as another super-optimist in respect of the gas turbine, said that the definition of the terms research and development was difficult. On the extreme left of the research end of the spectrum of technical progress there was the quest for basic truth. At the extreme right of the development end of the spectrum there was the manifestation of truth in the form of hardware. But as we approached the middle of the spectrum, definition became more and more vague; and no-one really knew where research ended and development began.

Because research had been responsible for attractive ideas like splitting the atom and bending rays of light, it had achieved a considerable dramatic appeal. Development *qua* development did not provide such exciting ideas. In point of fact, research and development were equally important and were part of one process.

Fuel Consumption

Air Comdre. Whittle had already discussed the author's views on the fuel consumption of the gas turbine. All that one could add was that the current habit of considering fuel consumptions in terms of lb./thrust h.p./hr: or lb./brake h.p./hr., as the case might be, was apt to be misleading. As an illustration, the gas turbine was a power plant for high-speed aircraft; and it must be remembered that if aircraft "A" travelled twice as fast as aircraft "B," but the power plant of aircraft "A" consumed fuel twice as quickly as the power plant of aircraft "B," then "A" and "B" would consume the same amount of fuel in a given distance. So that it would be very rash indeed to assume that, because a power plant had a higher fuel consumption than another on the usual hourly basis it was necessarily less economical when in operation in the air. He believed, with Air. Comdre. Whittle, that the greatest overall economy would be achieved with the gas turbine even if it did not achieve fuel consumptions on the lb./hr. basis as low as those of the piston engine; though he believed it would do that still.

It was interesting to learn that the author believed it would never be possible to bury engines completely in wings, although he had made exceptions in the case of very large aircraft or those having a great multiplicity of power units. He might be right. But it had not yet been proved whether the lowest drag was obtained with a large fuselage and highly loaded thin wings with large protuberances, or a minimum of fuselage with a lightly loaded wing capable of embracing the engines and most of the rest of the load. Moreover, it might be

POWER UNIT DEVELOPMENT

possible to install a relatively large number of very small gas turbine engines across the span, and Dr. Roxbee Cox felt that it would be worth while for designers to explore the possibilities of such a scheme before dismissing it.

It was also very interesting to find that everyone subscribed faithfully to the time-honoured doctrine that the gas turbine engine and the airframe must be designed together and each made to suit the best overall design of aircraft.

So far he did not feel that the aircraft designer was being very enterprising in his applications of the gas turbine. Too many of the layouts were just ordinary aircraft with invisible airscrews! That *might* be the right formula, but we should try some much less conventional ones before deciding that that was the way to exploit the gas turbine to the full. We should probably have some failures, but we might find a winner.

Poppet *v.* Sleeve Valve

MR. TRESILLIAN, discussing the comparison between sleeve and poppet valves, said that at present they gave approximately equal valving in existing engines. As pointed out many years ago by Dr. Ricardo, the maximum port area obtainable in sleeve valves was fixed by the motion of the valve and could not be increased.

However, there were still possibilities of development in poppet valves, and there need not be any limitation on piston speed.

Increased valve area could be provided by abandoning the seat insert and using steel heads or steel-lined heads, and further by a change to the three-valve penthouse arrangement which favoured inlet valves, usually the limitation. At least 25 per cent. more valve area could be obtained, and valving experiments showed that, other limitations apart, piston speed could be increased roughly in proportion to the inlet valve area as a percentage of the piston area. If valve gear speed could also be raised, piston speeds could be raised by increasing engine r.p.m. without increase of stroke. From investigations of existing four-valve engine valve gears it appeared quite possible to increase the operating speed from 3,000 to over 4,000 r.p.m., even retaining the existing valve springs, purely by changes in cam and rocker kinematics, which were not by any means the best on modern engines.

MR. R. W. DUNCAN commented that we had grown accustomed to comparing the reciprocating engine of to-day with the gas turbine of to-morrow.

Confining his own remarks to reciprocating engines, he suggested that the author's comments on the relative merits of sleeve-valve and poppet-valve engines were a little unfair, since he was comparing two things which were not quite comparable. Poppet valves had been developed over 70 years, whereas sleeve valves had been developed over about 18 years. The sleeve-valve engine had reached a stage at which it was an entirely practicable production proposition; it had just reached or was just reaching the crest of the first wave, and there were others which it had to get over. With big cylinders and a good induction system the sleeve-valve engine could be run at piston speeds 20 per cent. in excess of the 3,250ft. per minute quoted by the author. It was also true that poppet-valve engines could be run at very high speeds; but he believed the sleeve-valve engine could accommodate the very high piston speeds more easily and simply.

Coming to the problem of air versus liquid cooling, Mr. Duncan urged that, given the same installed weight, the air-cooled engine could have just as good heat-capacity factor as the liquid-cooled, using well-proportioned fins and high-conductivity material where necessary. Both must have fan or exhaust-ejector cooling in any case. He did not believe there was anything to choose between them.

As to the comparison between in-line and radial engines, it seemed that the author of the paper favoured the in-line, presumably because he considered the aim should be to have as few cylinders as possible per crankpin. But nine cylinders per bank had been used for many years and had proved satisfactory. One of eleven cylinders per bank had been made or contemplated. Surely there was plenty of scope for the two-row eighteen-cylinder radial air-cooled sleeve-valve engine of up to 6½in. bore, as opposed to the 6in. bore poppet-valve engine. It would be difficult to beat in the "Carter Paterson" type of civil aircraft for the next seven or eight years. Crediting it with twelve times R.A.C. rating, it should give 3,650 h.p.

Bearing in mind the four-row "Pancake" Diesel engine made by General Motors, Mr. Duncan suggested a layout for a large reciprocating engine for use in the long-range "Carter Paterson" machines, flying boats, and over-ocean military reconnaissance machines. He had in mind a six-row, liquid-cooled, 90-deg., sleeve-valve two-stroke, with single-piece crank and slipper rods. Such an engine, of 6½in. bore, should be quite suitable as a high-power unit.

MR. OWNER found discussion of the paper difficult because of the very deep conviction with which he shared the author's views on aircraft engine development and the importance of its timing. This could hardly be exaggerated, and particularly the timing of power unit and aircraft development needed more synchronising than it had received in the past. In the case of turbine units it was necessary that the research and development programmes should dovetail with the corresponding aircraft work in addition to "tailoring" the turbine itself to suit its aircraft. In particular, the use of turbines would open the way to many novel possibilities in controlling or modifying the airflow over the aircraft surfaces, and that investigation must necessarily be a joint affair.

In reviewing the importance of development work, was it not more important now than ever to develop each separate section of any proposed new power plant separately, with its own appropriate test plant, thus limiting and controlling the number of independent variables? Inasmuch as development nearly always tended towards increased complication, he entered a plea for simplicity wherever it could be achieved. Very often, he said, the amount of complication of a design varied inversely with the amount of design thought put into it. The general trend of increased complication would no doubt apply to the gas turbine as to most things hitherto, but it was to be hoped that only those unavoidable complications which earned their keep would be added to what was an inherently simple type of power plant.

As an example, he said the complication of the exhaust turbo might have to be incurred in order to utilise energy otherwise wasted in the reciprocating engine's exhaust. If, however, that energy had to be returned direct to the crankshaft instead of the supercharger, the inherent inflexibility of such an arrangement might drive us perforce to the additional complication of multi- or infinitely-variable speed gearing. Finally, he asked if the author would agree that we were only yet at the outset of fuel investigation for gas turbines. Fuel development for reciprocating engines had been very largely directed to the factor of detonation, which was not an issue at all in the turbine. Attention could, therefore, be directed to safety, low vapour pressure and high calorific value, which were primary qualities.

MR. A. R. OGSTON was impressed by the author's conviction that all the piston engines really were going to be superseded within the next decade. Incidentally, that innovation also meant that millions of pounds worth of oil refinery equipment for manufacturing high-octane aviation fuel would likewise become redundant, although it was true that that equipment could be diverted to the production of high-grade petrols for motor cars, where, owing to its greater flexibility, the piston engine would remain supreme for many years.

Cruising Power

He was a little surprised by the low figure of 35-40 per cent. which the author seemed to imply was an optimum cruising power for engines developed to give high take-off power. His previous impression was that an optimum ratio of cruising to take-off power for the average transport aircraft was at least 50 per cent; in fact, he had seen recent analyses which indicated that revenue-earning capacity was improved by operating at comparatively high cruising speeds which might necessitate using up to 65 per cent. power, even though that appreciably lowered the air miles per gallon and reduced engine overhaul periods. If engines were developed to give high take-off power, should not the development also permit high cruising power? It seemed to him that if engines were capable of sustained cruising at 50 or 60 per cent. or so of their maximum output—as he suggested they should be—cruising at only 35-40 per cent. was tantamount to carrying a load of excess engine weight which did not pay any fare.

Discussing safety fuels, he pointed out that the hazard in regard to increased range of explosive fuel/air mixtures in the tanks of military aircraft with a fuel of low volatility was eliminated by the use of inert gas in the vapour space of the tanks, which he imagined should be a pre-requisite of future designs. In addition to preventing loss due to evaporation in flight, safety fuel would also eliminate completely the bugbear of fuel vapour locking at high altitudes or during rapid climb in very warm weather and other difficult conditions.

Mr. Ogston submitted that fuel was one of the most important single factors affecting the development of both piston engines and gas turbines.

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BRITISH CARRIERS IN THE PAC

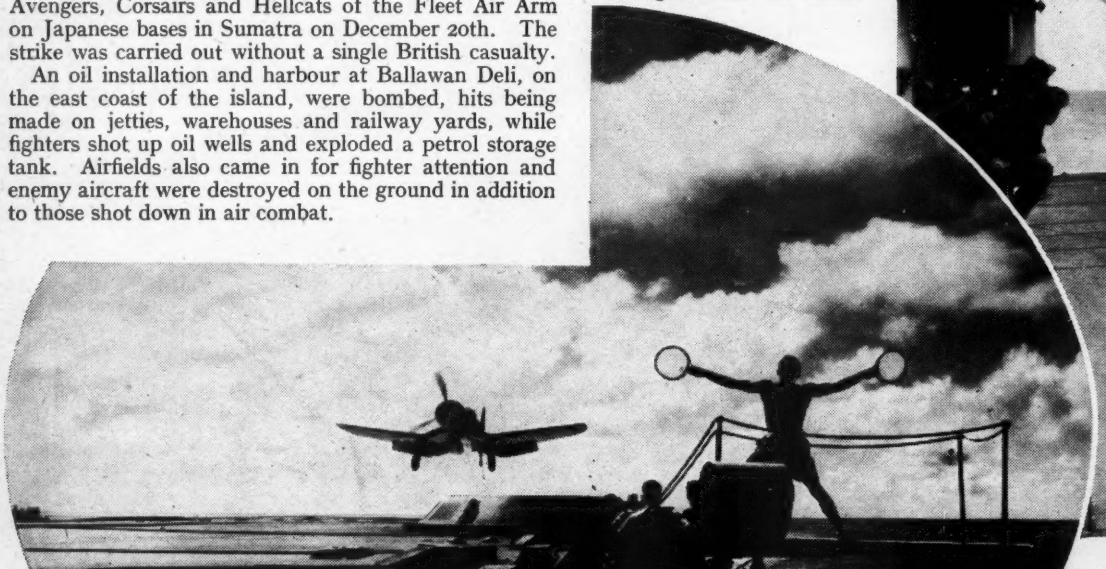
Fighters a
bombers
Sumatra

RECENT attacks by carrier-borne aircraft of the U.S. Navy on targets in the Japanese mainland have focused attention on the vital part being played in the Pacific theatre by this section of the Allied Air Forces.

These pictures were taken during an attack by Avengers, Corsairs and Hellcats of the Fleet Air Arm on Japanese bases in Sumatra on December 20th. The strike was carried out without a single British casualty.

An oil installation and harbour at Ballawan Deli, on the east coast of the island, were bombed, hits being made on jetties, warehouses and railway yards, while fighters shot up oil wells and exploded a petrol storage tank. Airfields also came in for fighter attention and enemy aircraft were destroyed on the ground in addition to those shot down in air combat.

1 A Corsair, piloted by a Lieut.-Commander, about to take-off from the flight-deck to lead his fighters into the attack.



3

3 Making a perfect appro
with flaps and undercarr
lowered and arrester-h
extended, a Corsair figh
pilot receives the "land-
signal from the batsma
returning from his miss

5 Popularly known in the Servi
the "Chicago piano," the e
barrelled multiple pom-pom for
very useful part of the aircraft-car
anti-aircraft armament. This clo
view gives a good idea of the co
cations of this "musical instrum

PACIFIC

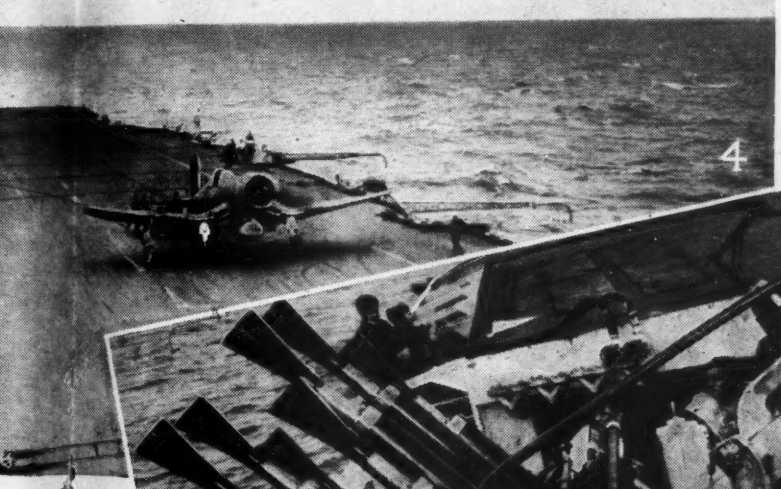
Fighters and Dive-bombers Attack Sumatra Targets

2 A Grumman Avenger, its take-off with full bomb-load assisted by the catapult seen on the left, climbs steeply away using a small degree of flap.

LOCATED

4 Corsair comes to rest on the flight-deck, having landed nice and short; the stretched arrester-wire can be seen to the left of the machine. Another Corsair is seen stooging around awaiting its turn to land-on, flaps and undercarriage lowered in readiness before making the actual approach

LIBRARY



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8.25

EVERY MORNING for nearly 40 years Mr. Black has left his suburban home to catch the 8.25 to town. Sometimes it was a bit late — fog and all that. But ask Mr. Black if the 8.25 ever failed to arrive; or gave up half way on account of 'engine trouble.' "My dear, fellow," he'll say, "engine trouble! The 8.25!!!"

Very soon Mr. Black is going to catch the 8.25 'plane to Moscow, or maybe Montreal, with just the same sure confidence. Ground Service will play a big part in building confidence in air travel. Ground Service is our business.

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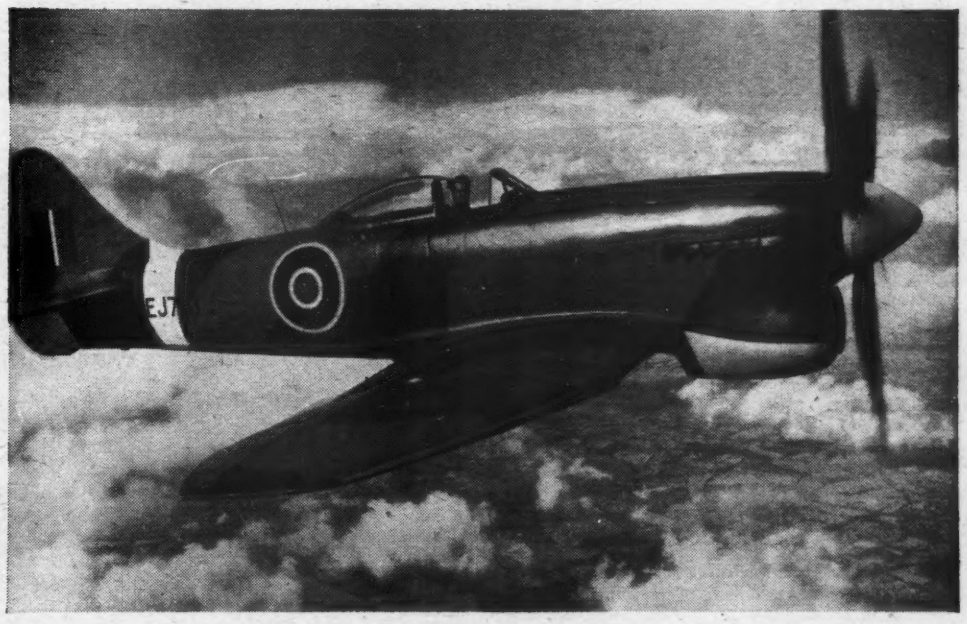
HAWKER TEMPEST V



This breezy study of the Tempest V in flight gives a good idea of the high quality of surface finish and emphasises the aircraft's cleanliness of outline. The bubble hood is controlled mechanically.

A SURVEY OF THE LATEST HAWKER FIGHTER : GREAT SPEED AND MANOEUVRABILITY

THE initial impression gained when first taking a look at the Tempest is that the aircraft is just a Typhoon with a different wing. This impression is not wholly accurate although the Tempest was originally conceived as a modified Typhoon, but by the time the design staff had finished their work on the prototype it was found that they had created virtually a completely new machine.

When the Typhoon was originally designed in 1937 it was given a fairly high-lift wing with a root thickness which was satisfactory at speeds in the 400 m.p.h. region; however, for very high speeds, such a wing would inevitably be subject to compression troubles, and so, in 1941, it was decided to give the Typhoon a thin wing and to improve its aerodynamic cleanliness. In such fashion was the Tempest created.

Design Differences

Hawkers had realised for some long time that a really thin-section, laminar-flow wing was bound to be required sooner or later, and in 1940 they started to get down to the job of evolving one.

It says a great deal for the *timbre* of Hawker technicians that the wing section was created theoretically and proven in a tunnel, where it was confirmed that the job they had done was right, for no modification was necessary in the light of the tunnel tests.

An "elliptical" plan-form wing was chosen for the Tempest as being in itself the most efficient. A further advantage is that the greater chord at outboard stations allows of the cannon being housed completely within the wing, thus giving further aerodynamic advantage. Tips were originally pointed, but later were cut in order to bring the ailerons right out to the tip and so improve the rolling characteristics. In point of fact the Tempest rolls faster than any aircraft in the world—a good deal faster than the Fw 190. Having decided to give the machine a thin wing, it was necessary to provide a large main fuel tank in the fuselage. Centre of gravity considerations fixed its position as being between engine and cockpit, and thus made necessary increased nose length forward of the c.g. This, in turn, made necessary an increase in fin and tail-plane area to compensate, with the result that the only main components common to both Typhoon and Tempest became the engine and the monocoque rear fuselage (exclusive of the tail).

The 24-cylinder, sleeve-valve Napier Sabre IIB engine is carried in a typically Hawker mounting of tubular struts arranged to form two triangulated cantilever beams suspended from the four fuselage longeron terminal points. Spanning the front ends of the mounting beams is a massive light-alloy stamping incorporating two platforms for the front anchorage of the engine. This cross-member is carried on bonded metal-to-rubber sleeves over the ends of the top mounting tubes and thus provides a cush mounting and at the same time is capable of fore and aft movement on the tubes to allow for longitudinal expansion of the engine.

Front Fuselage Structure

The unit comprising engine coolant radiators on each side of a central oil radiator is suspended in straps from two light-alloy transverse box-beams which are mounted beneath and behind the front engine-mounting cross member.

As previously stated, the Tempest's main fuel tank is housed immediately behind the engine, and fits snugly between front and rear firewalls, the foremost of which carries a shaped piece of armour plate, the engine protecting the lower parts of the tank. This tank, which is of mushroom section, runs almost the full depth of the fuse-

HAWKER TEMPEST V

lage and is, of course, self-sealing; but a very unusual feature is that a tunnel runs diagonally through the tank in order to accommodate a diagonal bracing strut. Beneath the fuel tank are the filters and cocks, which themselves are protected by pieces of armour plate.

The proven Hawker method of steel-tube girder framework is arranged for the front fuselage with upper and lower longerons on each side and intermediate longerons at cockpit floor level. These several members are braced vertically and diagonally, whilst at all major joint stations cross bracing is also employed. In many instances throughout the front fuselage and engine mounting structure, where bolts pass diametrically across tubes and require a bearing surface at their ends only, the central body length of the bolt is greatly reduced in diameter, and a considerable saving in structure weight is claimed for this very ingenious feature.

Integrated with the front fuselage structure are the spanning members interconnecting the front and rear wing spars. The foremost of these spanning members is composed of top and bottom large-diameter tubes with diagonal bracings between, and is located immediately behind the front firewall. In the ends of the massive cross-tubes are bolted forged fittings with lugs which pick up in the fork-end fittings on the spar ends. The high tensile steel taper pins which locate in taper bushes in these fittings are horizontal, whereas those for the rear spar attachment are vertical.

Series I Tempest aircraft had a tubular spanning member for the rear spar attachment, which necessitated cranked fittings on the spar boom ends for picking up, but the series II machines have instead a 60-ton high-grade steel casting for the interconnecting spar member, which has been designed to allow of normal straight pick-up without cranked fittings.

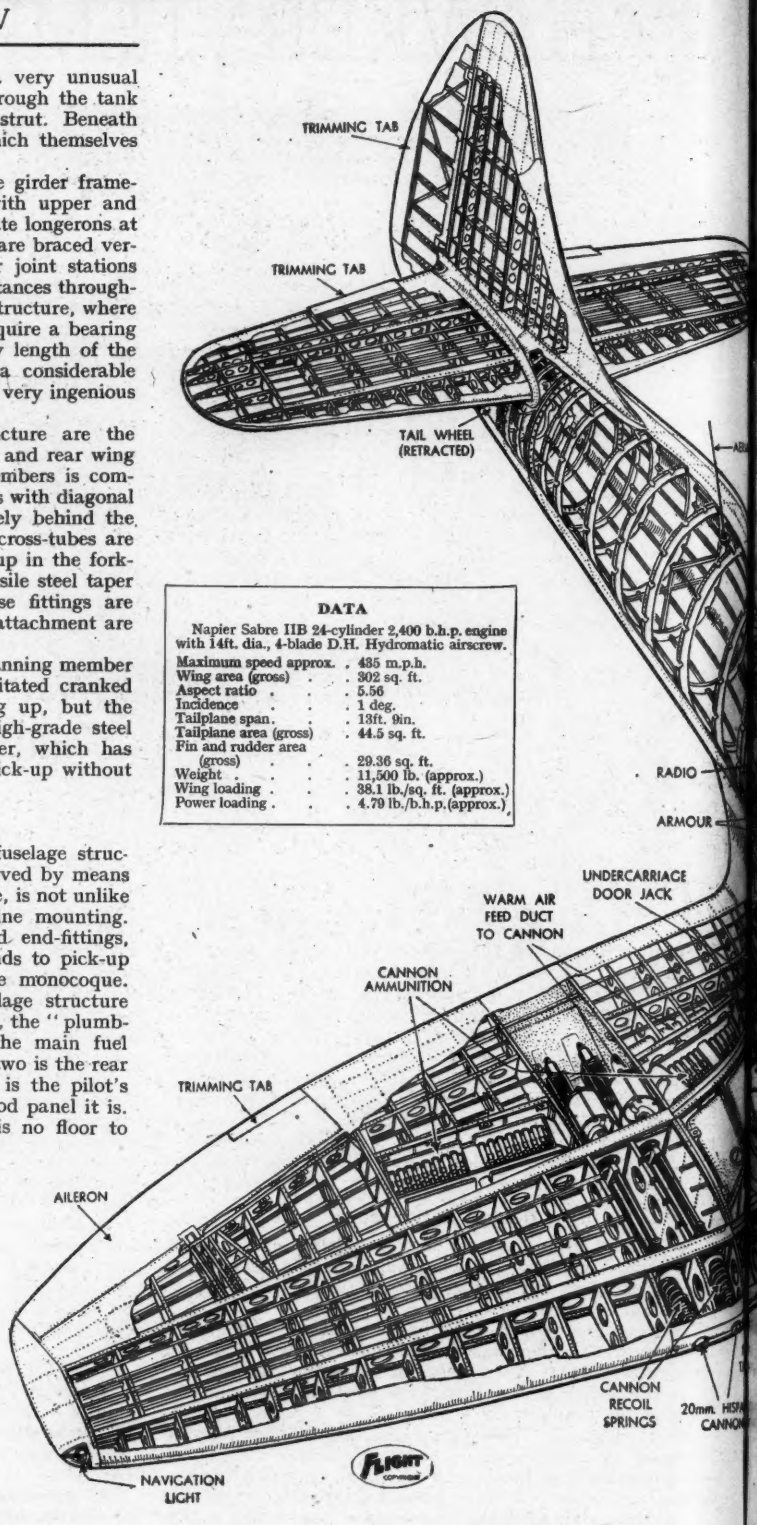
Cockpit Considerations

Change-over from the girder-type front fuselage structure to the monocoque rear fuselage is achieved by means of an integrating structure which, in principle, is not unlike the triangulated structure of a radial engine mounting. The structure is of steel tubes with forged end-fittings, and the members run from the longeron ends to pick-up points on a strong box-section frame in the monocoque.

In addition to the pilot, the front fuselage structure houses a mass of equipment and, at first sight, the "plumbing" is an absolute nightmare. Aft of the main fuel tank is fitted the oil tank, and dividing the two is the rear firewall. Immediately behind the oil tank is the pilot's instrument panel and, in general, a very good panel it is. As in the Hurricane and Typhoon, there is no floor to the cockpit as such, but splayed heel trays run from the seat to each of the rudder pedals, and the only inconvenience of not having a floor is in dust, draughts, and the possibility of accidentally dropping something.

Two fore-and-aft tubes run between the front and rear spar-spanning members, and on these are mounted the rudder bar pivot pedestal and the cranked bracket on which the wrist-action control column is pivoted.

Cockpit layout is, on the whole, good, and in accord with British practice, but there are one or two points worthy of criticism. With the seat adjusted for normal height the boost gauge cannot easily be seen—it would be better placed below the r.p.m. indicator instead of to the right of it. The rudder trim control is unhandy and difficult to reach except with the finger tips, especially when gloved, and it might well be either tilted



DATA

Napier Sabre IIB 24-cylinder 2,400 b.h.p. engine with 14ft. dia., 4-blade D.H. Hydromatic airscrew.

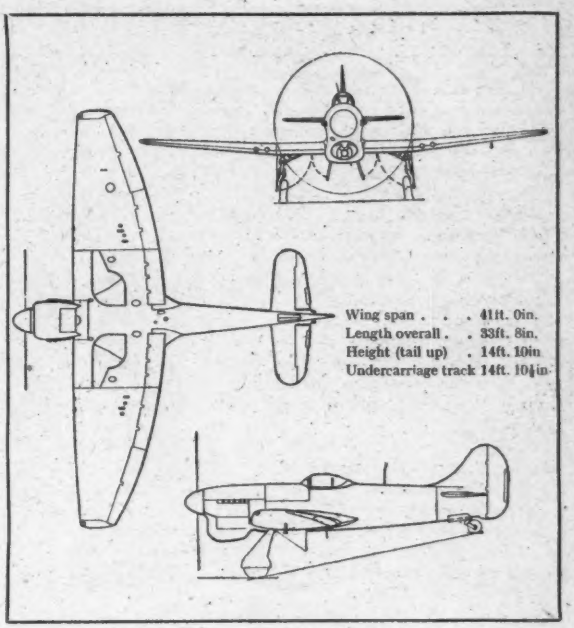
Maximum speed approx.	435 m.p.h.
Wing area (gross)	302 sq. ft.
Aspect ratio	5.56
Incidence	1 deg.
Tailplane span	13ft. 9in.
Tailplane area (gross)	44.5 sq. ft.
Fin and rudder area (gross)	29.36 sq. ft.
Weight	11,500 lb. (approx.)
Wing loading	38.1 lb./sq. ft. (approx.)
Power loading	4.79 lb./b.h.p. (approx.)

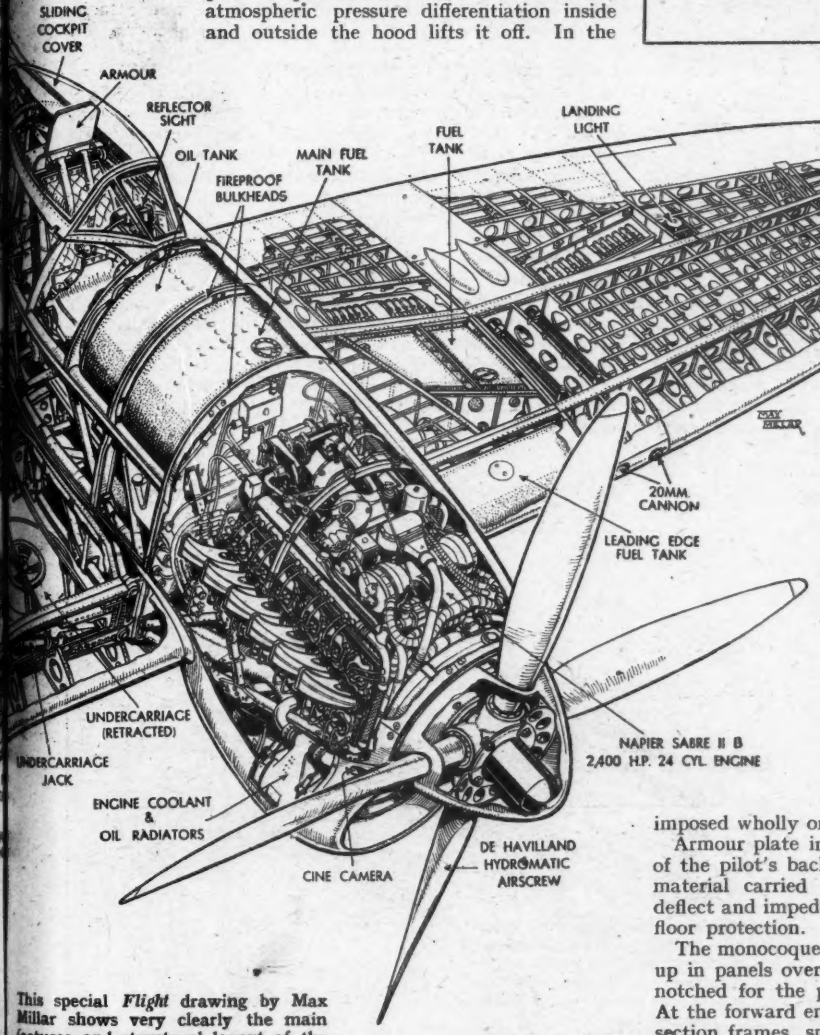
inwards or moved bodily inwards on a modified bracket. The undercarriage control lever gate on the port sloping panel is almost continually in contact with the calf of the left leg, and to avoid the constant brushing and vibration the pilot has to sit rather knock-kneed; this, however, is a trifling inconvenience. The same cannot be said for compass reading as, with the compass located beneath the flight instruments in the centre of the panel, view of it is completely masked by the control column, and to see the instrument either the head must be craned forward (not very easy in seat harness) or the stick pulled back, putting the aircraft into a climb which, of course, can conceivably induce acceleration error.

Hood Jettison

These points vary in importance and can be overcome by getting used to the aircraft—nevertheless, anything making the pilot's job a trifle more difficult than it need be is undesirable.

A single-piece "bubble" Perspex hood encloses the cockpit and runs in side and rear rails. The hood is wound back and forth by chains and sprocket from a control forward of the pilot's left shoulder. A system of spring-loaded cables at the forward monocoque box-frame allows of releasing the hood in an emergency; a toggle handle in the lower right of the instrument panel is pulled, the rails are released and atmospheric pressure differentiation inside and outside the hood lifts it off. In the event of a pilot being damaged and making a forced landing, or if he should become unconscious and unable to help himself, there is no means to the uninitiated by which he can be released. A simple external handle with a large painted instruction would allow the farm labourer or local policeman to get the pilot out.





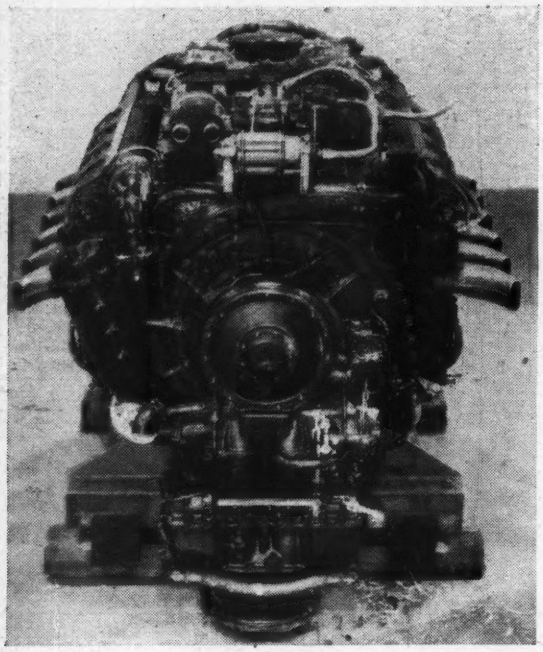
This special *Flight* drawing by Max Millar shows very clearly the main features and structural layout of the Hawker Tempest V.

The bullet-proof front screen is of the dry-air sandwich type, and a row of tiny holes in the scuttle allows of anti-icing spraying.

As on the Typhoon, the pilot's seat is carried on a cross-tube anchored at each end in vertical slots and bearing on hefty compression springs. At high rates of turn or sharp pull-outs from dives the springs are compressed and absorb some of the g-force normally imposed wholly on the pilot.

Armour plate in three separate slabs protects the whole of the pilot's back, shoulders and head, and the mass of material carried in the belly of the cockpit would so deflect and impede bullets or shells as to provide adequate floor protection.

The monocoque rear fuselage is a stressed-skin shell built up in panels over deep-Z section hoop frames, which are notched for the passage of the top-hat section stringers. At the forward end of the monocoque are two strong box-section frames, spaced about 22in. apart, to the foremost of which the integrating structure is attached.



Rear aspect of the Tempest's 2,400 h.p. Sabre engine. Note the four-branched supercharger volute and the neat grouping of accessories over the top cylinders.

Although the extreme tail of the fuselage is of modified monocoque construction it is built as a separate sub-assembly and is joined to the fuselage proper at a transport joint beneath the dorsal fillet of the fin.

Elevator Control

Aft of the transport joint and enclosing the forward end of the tailwheel well is a diaphragm bulkhead, on the front face of which are carried the brackets for mounting the elevator control cross-arm and the mass balance. The latter is a lead weight carried on the end of a fairly long arm and crank-pivoted to the cross-arm on which the control cables terminate, the weight of the mass balance tending to pull up the elevators. Whilst on the subject it may be well to mention that a cast-iron weight is fitted to the forward side of the pilot's control column at the base, tending to pull the column forward, and although of opposite action to the mass balance proper has nothing to do with elevator action. It was found that the sensitivity of the elevators at high speed induced vibration in the "stick," so the weight was incorporated as an inertia-type damper. Elevator control is excellent but, as is natural in high-speed aircraft, is inclined to fade at the bottom end of the speed range.

Behind the diaphragm bulkhead is the spanning member for the tailplane front spar, this member consisting of upper and lower tubes with end fittings for spar pick-up. The member inter-connecting the rear spars is similar in construction.

HAWKER TEMPEST V

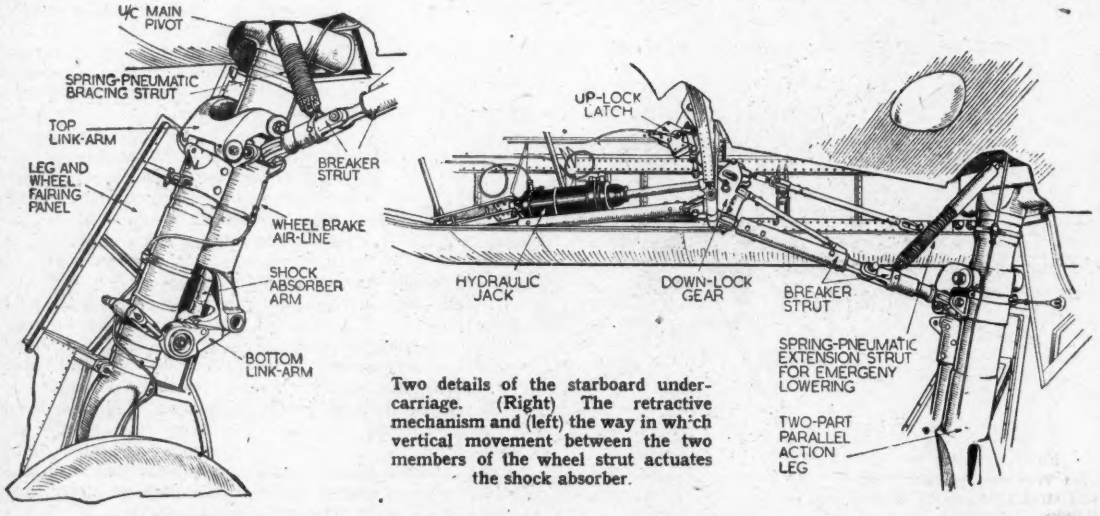
Tail Unit Structure

Horizontally inside the fuselage tail is a decking beneath which is housed the tailwheel. The tailwheel strut is pivoted at its base to retract forward and is anchored in two U-form built-up members raked to form a V at the tail strut pivot.

The fin proper is similar in construction to the Typhoon's, being of stressed skin over three vertical posts between which are horizontal filler plates forming rib-like members. Vertical stringers are also used, and attachment of fin to fuselage is by flanged plate members riveted to ribs and skin.

Only the rudder on the Tempest is fabric-covered, and it is built up on a tubular spar or post to which a leading-edge nose fairing is riveted. From the nose fairing ribs extend to the trailing-edge profile tube. The rudder is swung on three split needle-roller bearings carried on the rear fin post, and the cross-arms to which the rudder control cables are secured are mounted just above the middle hinge; above the cross-arms the rudder mass balance (a large lead weight) is carried on two brackets attached to the rudder post. There appears to be no aerodynamic balance of the rudder in the accepted sense of the term, but owing to the thickness of the rudder, the nose fairing, which is at a constant radius about the hinge axis, projects well forward of the rudder post and is enclosed within shrouding side extensions of the fin skin plating. In the trailing-edge of the rudder is a fairly large trim tab which is actuated by a screw jack controlled by cable from the cockpit.

The tailplane is a two-spar structure, both spars having sheet webs with T-section extruded booms, and there are six main inter-spar diaphragm-type ribs, all of which are



Two details of the starboard undercarriage. (Right) The retractive mechanism and (left) the way in which vertical movement between the two members of the wheel strut actuates the shock absorber.

HAWKER TEMPEST V

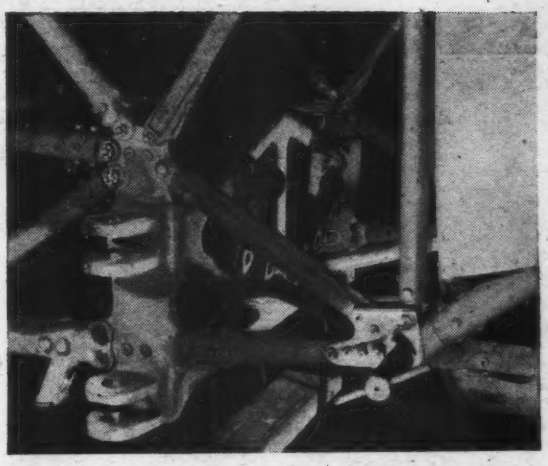
notched for the intercostal stringers. Leading-edge skin plating is carried on diaphragm nose ribs, and aft of the rear spar are trailing-edge ribs extending to the elevator shrouding. Tailplane attachment is by high-tensile steel fittings at the spar ends, which carry studs for bolting-up to the butt ends of the spar interconnecting members.

Elevators are swung on two split needle-roller hinges carried on the tailplane rear spar, and are built up round a channel-section spar to which is riveted an isosceles cross-section single-piece nose fairing. Ribs are of pressed sheet and terminate at the trailing-edge profile strip, and a single stringer, top and bottom, extends spanwise over the ribs. Trim tabs are pivoted in Oilite bushes at each end and are actuated by a worm and segment screw jack controlled by cable from the cockpit.

Between the inboard end of the elevator and the fuselage skin on each side is a fairing piece—almost a fillet—in the rear extremity of which is carried the rearward navigation light. These fairings serve as a frontal mask for the rudder control cross-arms and at the same time house the rudder cables.

Wing Design

Structurally as well as aerodynamically, the wings of the Tempest are probably the most interesting thing about the machine. Externally, the impression of a centre section is given by the inner wing panels having a horizontal spanwise datum and the outer panels having a dihedral angle of 5½ deg. Front and rear spars are of similar construction, although the rear spar is cranked sharply forward from the attachment point to the dihedral break, this measure allowing the main wheels to be retracted and housed between the spars and also allowing the cannon and ammunition boxes to be housed behind the rear spar. Tempest V aircraft are armed with the Mk. V Hispano 20 mm. cannon, which is about 12in. shorter than the Mk. II type previously fitted, and thus permits of the cannon muzzles being contained within the wing leading-edge line. Absence of barrel fairings projecting forward of the leading-edge is of considerable advantage in reduction of drag, and the "blisters" over the cannon breeches in the wing top surface are sufficiently far back not to interfere with the laminar air flow, the important region for this condition being that contained within 60 per cent. chord from the leading-edge. In this connection, the rivet heads of skin attachment on wings and tailplane to 60 per cent. of chord are filled with an elastic compound in order to give a smooth surface finish and enhance laminar flow.



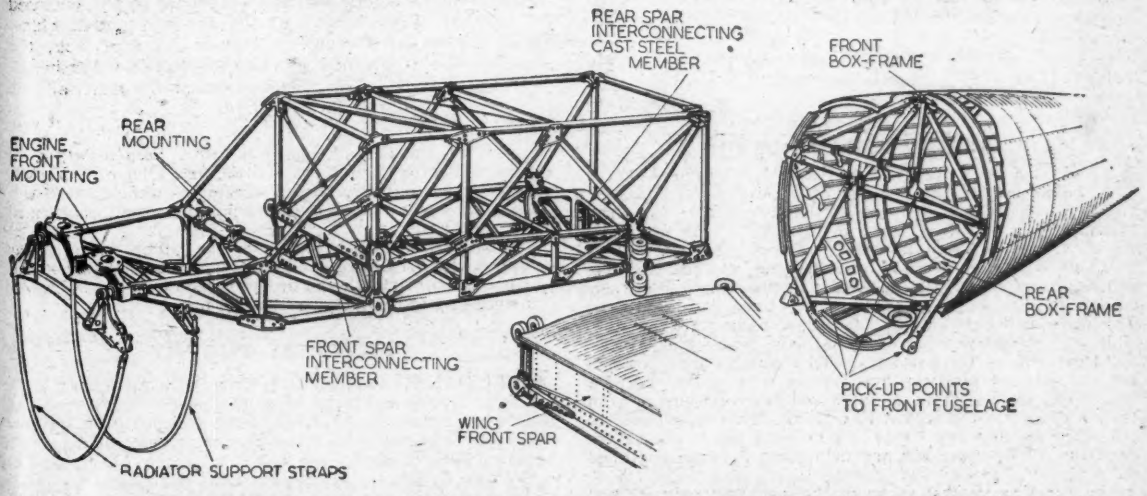
The 60-ton high-grade steel casting which spans the front fuselage structure to interconnect the rear spars of the wings. The pulleys on its rear face are fairleads for flying control cables.

Spar structure is of plate webs with, from root to dihedral break, T-section booms made up by two L-section extrusions riveted together; outboard the booms are T-section extrusions riveted on one side of the web. At the dihedral point the break in the spars is made with H.T. steel butt strap stampings through-bolted to the boom extrusions; the spar webs lap each other with a vertical cover plate which is riveted to the web of the inter-spar rib at this station.

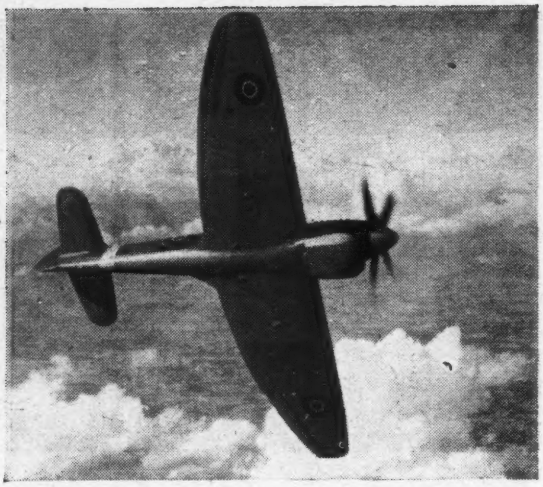
Spar/Skin Torsion Box

The undercarriage wheel well and the well for the inter-spar fuel tanks are enclosed by diaphragm members, and the wing surface over these wells (where doors do not occur) incorporates heavy longitudinal stiffening and a number of lighter lateral stiffeners.

Inter-spar ribs of diaphragm type are fitted outboard of the dihedral break and are notched for the intercostal stringers. An interesting feature of the wing structure is that the skin plating varies in thickness according to the local stress distribution, and outboard of the dihedral break heavy-gauge plating is used to form with the spars a very rigid torsion box. Forward of the front spar the outer wing leading-edge nosing is carried on 18 diaphragm ribs; in the leading-edge inboard of the dihedral break a fuel tank is carried in the port wing only—in the starboard



Front fuselage structure including engine mounting and rear monocoque fuselage with integrating structure. Pick-up points between the two units can be seen together with the wing attachment arrangement.



The Tempest's neat lines and purposeful appearance are admirably illustrated above as the machine banks away in a turn to port.

wing the leading-edge construction is similar throughout the span.

Aft of the rear spar are spanwise sub-spars of light-alloy flanged webs, and from the rear spar in connection with the sub-spars, tail ribs support the trailing-edge skin and are recessed to accommodate the split flaps. These are in four parts, two per wing, the joint being at the dihedral break and linkage between the flap spars at this point arranged through a universal joint. Each flap is built up with a single under-surface skin on flanged-web ribs attached to a tubular spar. Double-acting hydraulic jacks actuate each pair of flaps, the jack being anchored to the lower boom of the rear spar and the piston rod attached direct to a lever arm off the flap spar. Coincident and balanced motion is ensured by a spar extension spanning the fuselage, and each flap is swung in three plain bearing hinges.

The Frise-type ailerons are rather small in area at first sight, although they are supremely efficient, as is evidenced by the amazing roll characteristics of the aircraft. A particular point of interest of these units is that pre-tensioning is applied to the skin, which is built up on light diaphragm ribs attached to the channel-section spar incorporating a leading-edge nosing.

There are no trim tabs fitted to Tempest ailerons, although small adjustable tabs which can be set and locked on the ground are fitted in the trailing-edge at the inboard end.

Cannon mounting is neat and ingenious, the breech body being mounted in a bronze-lined trunnion and the slide action governed by turnbuckles which are employed to

HAWKER TEMPEST V

adjust rate of fire for harmonising. The trunnions are mounted on the rear face of the rear spar, the web of which has holes for the passage of the barrels, these being shrouded with leather coats. Additionally, the emplacement is lined internally with a bonded felt for heat insulation. Front mounting through the web of the front spar is by means of a spherical sleeve round the barrel, the sphere being retained in an eccentric housing which permits adjustment for elevation, deflection and fire coning. A very interesting feature of this fitting is that the gun barrel is carried within a series of annular V-section springs, alternate ones of which have a reversed section. These springs damp the recoil energy by friction engendered through their rubbing faces. Recoil is also taken upon the usual coil spring around the barrel end.

Undercarriage Layout

In the corner made by the junction of the front spar and the heavy inter-spar rib at the dihedral point is fitted a massive steel casting which is bolted to the spar and the rib. This casting embodies bearings for the spindle upon which the main undercarriage leg is pivoted, the hinge axis being raked so that retractive motion is rearward as well as upward.

The wheel leg is a most ingenious piece of work, as the problem faced by the undercarriage makers, Dowty Equipment, Ltd. (who also do the aircraft's hydraulic system), was to design a cantilever axle leg which could be retracted into the very thin wing. To overcome the restriction the leg is made in two parts, upper and lower, staggered fore and aft and coupled by pin-jointed parallel linkages. Inside the hollow upper leg is housed the separate shock-absorber unit, the rod of which is pinned to the lower link arm. Thus relative movement between the two members of the leg is restricted by the shock-absorber—additionally, the intrinsic design of the leg is such as to combat landing-drag torque.

To lower the wheels in the event of the hydraulic system sustaining damage, two red-painted pedals are fitted outboard of the rudder pedals in the cockpit. These are connected to the up-locks of the undercarriage and, when released, the wheels fall under their own weight. However, the legs will not fall the full amount without assistance. This is provided by the aircraft's air system, which is used to inflate a bag inside the spring-pneumatic strut and so extend the legs through their final movement to the locked-down position.

Each leg strut and wheel is faired by panels carried on the leg, but when retracted the wheels are totally enclosed by separate doors hinged to the fuselage undersurface. These are actuated each by its own separate jack, the sequence being governed by a hydro-electric valve in the hydraulic system. The tailwheel lowers automatically in the event of hydraulic system failure.

AIR VICE-MARSHAL'S TRIBUTE

MAKING a farewell speech to Group Headquarters officers before leaving the R.A.F. Bomber Command Lancaster Group which he had commanded for two years, Air Vice-Marshal E. A. B. Rice, C.B., C.B.E., M.C., paid a special tribute to the W.A.A.F. and the Engineering Section.

"The W.A.A.F. came to us," he said, "when we were suffering from a man-power shortage. Quite apart from their pleasant company, the assistance they have given has been absolutely incredible. They have helped us in every way possible. I don't know what we would have done without them.

"I experienced the last war, and I remember that, towards the end, life got pretty grim. We are nearing the end of a war in Europe once again, and it would have been just as grim if we had not had the W.A.A.F. with us. They have added to our efficiency in many ways, and in some departments have done the work better than any man could have accomplished it."

The Air Vice-Marshal spoke of the way the engineers had raised the serviceability of the aircraft until it was nearly 100 per cent. It was only after operations had been sustained for a long period that it dropped a little, and a lot of the credit must go to the ordinary airman working on airfields, who was often blamed when things went wrong, and sometimes blamed when they went right.

Air Vice-Marshal Rice took over the Group when it was equipped with Wellingtons and Lancasters. At that time it had just had a record month and dropped 1,000 tons of bombs. It has since dropped over 15,000 tons in one month.

SARTORIAL TROPHY

A BELGIAN Spitfire pilot of 83 Group of R.A.F. 2nd T.A.F. recently returned from an attack on an electric train at Rheine with most of a pair of German field service trousers hanging from a *flak* hole in the wing, apparently blown there by some freak of blast.

"We've caught the Huns with their pants down before," commented the pilot, "but this is the first time we've come home with them."

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International Air Transport Association

PRELIMINARY FRAMEWORK FOR A WORLD-WIDE BODY : PROPOSED UNION OF INTERNATIONAL AND DOMESTIC AIRLINE OPERATORS

THE Chicago Conference presented an exceptional opportunity for airline operators to meet and exchange views on their post-war co-operation. This opportunity was fully appreciated, and on December 3rd an invitation, signed by Mr J. R. McCrindle, of the B.O.A.C., Col. F. Flocon, of *Transports Aeriens Français*, and M. Roushdy, of Misr Air Lines, was extended to airline representatives present at Chicago to attend a joint meeting. Col. E. Gorrell, of the Air Transport Association of America, invited Dr. Goedhuis, of the I.A.T.A., and Mr. F. Farey-Jones, of the C.I.A.T.O., to take part in the discussions.

Because of the existence of two international organisations, the I.A.T.A. and the C.I.A.T.O., it was at first expected that preliminary discussions would be held between Col. Gorrell and the representatives of the two bodies. But it was found possible to short-circuit the procedure, and on December 7th a very representative meeting was held under the chairmanship of Mr. Herbert Symington, of Trans-Canada Airlines, with representatives of some 31 airline companies attending.

At this meeting a drafting committee was appointed to prepare a plan of organisation and articles of association for an International Air Transport Association. The members of the drafting committee are Col. Pedro A. Chapa, Mr. John C. Cooper, Col. Flocon, Dr. H. J. Gorecki, Dr. Luis Machado, Mr. J. R. McCrindle, Mr. Per A. Norlin, Mr. John Slater and Dr. Goedhuis.

The first stage of this committee's work is now completed. The framework of the organisation laid down in their memorandum is, of course, purely tentative and is at present in the hands of airline operators for their study and comment. On the basis of their observations a final draft will be submitted to the plenary session of airline operators for their approval and acceptance at the next general meeting at Havana on April 18th.

Preliminary Draft

It is more than likely that the present draft will undergo major changes before it emerges as final and generally acceptable. Although the drafting committee has done admirable work in a short time, such gradual evolution is indeed necessary to eliminate any weaknesses in the proposed set-up. The first fact that emerges from these preliminary steps is the desire of airline operators to establish a world-wide organisation replacing the pre-war I.A.T.A. and the war-born C.I.A.T.O. While it is possible, and indeed desirable, that the new organisation should be built on a regional basis, the unification of European, American, Asiatic and African operators marks the end of the existing confusion.

While hitherto international organisations of air transport have been confined to operators of international traffic, the new organisation proposes to accept into its fold domestic transport companies as well. This is an important step forward on the road to progress. Better standards of safety, uniformity and synchronisation of air transport may well result from such an all-embracing world-wide union.

But, wittingly or unwittingly, it seems that domestic operators are to be treated like the prodigal son. The membership of the proposed organisation is to be classified into (a) active and (b) associate members; the former being operators of international air routes, the latter "any other air transport enterprise operating under the flag of a State eligible to membership in the International Civil Aviation Organisation" (the Government body established at Chicago).

This qualification gives one the impression that it is proposed to keep the trade organisation on lines parallel to those of the Inter-State body and to eliminate *a priori* the participation of Axis and ex-enemy companies. The idea of keeping Axis companies out is, of course, sound, but why not say so in unmistakable terms? Even if it is desired to keep the door open for these companies in future (and one hopes that this will be only in the very distant future), provision could be made for the acceptance of such companies into the international fraternity being dependent upon unanimous agreement of all other members. At any rate, in its present framing the qualification for associate membership would appear somewhat ambiguous, open to misrepresentation and might be interpreted to the disadvantage of some colonial enterprises.

Associate Membership

Another flaw in the status of associate members is the lack of provision for any share in the management of the Association. Neither are they to have a vote nor any representation on the executive. While appreciating the impossibility of giving domestic operators, who may ultimately be in numerical majority, an equal share in the control of the organisation, one would expect them to be entitled to run their own show under the ægis of a "roof organisation" with some representation on the governing body. The rather undemocratic provision governing associate membership appears to offer little incentive to domestic operators to join the organisation.

One cannot help asking why the association of air transport operators should in any way reflect a Government organisation. While the co-operation of both is, of course, essential to the development of aviation, it would seem to be in the interests of all to steer clear of Government influence, of patterns accepted in inter-Governmental politics, and to let the air transport operators' organisation develop into an absolutely independent body.

In this connection the location of the new organisation's headquarters is of some importance. While this has not been yet decided, the drafting committee seems to have been impressed by the desirability of having the head office in the same city as the International Civil Aviation Organisation. On this seemingly secondary issue, one can foresee a good deal of controversy when the first general meeting at Havana has to make its decision. The tendency to have the headquarters somewhere on the American continent will not be welcomed by non-American operators. Nor does there seem to be any reason for placing it in one of the smaller European countries such as Holland or Switzerland. There is no need now to accommodate powerful German interests. Judging the matter strictly on efficiency factors, that is central location, it seems that London would be the best choice, with Paris following second.

The governing body of the future Association—the memorandum proposes—should comprise an executive committee composed of an honorary president and not fewer than nine nor more than 12 members. In keeping with its world-wide ramifications, a certain decentralisation is advocated, with branch offices operating at regional centres, each under a member of the central H.Q.s.

CIVIL AVIATION NEWS

TERMINAL AIRPORT

PRESTWICK airport in Ayrshire is not to close down, Mr. Lennox-Boyd, Parliamentary Secretary, Ministry of Aircraft Production, declared in the House of Commons.

Although the main terminal for international services must be near London, Prestwick is likely to be used as one of the alternative airports. The Government intends to provide for adequate air services for Scotland, and although Prestwick is expected to be a busy centre after the war, proposals for an international airport nearer London are now being studied.

A CANADIAN SERVICE

TRANS-CANADA AIRLINES will in the near future institute a daily schedule for its non-stop North America-United Kingdom passenger and mail service.

The service now operates three times weekly and is the only one of its kind in the world.

Trans-Canada Airlines will participate fully in the development of British Commonwealth air communications in accordance with the basic pattern agreed by the Commonwealth Governments at the recent Montreal meeting.

COMPETITION DANGERS

"GENERAL wide-open post-war competition in foreign air services would be complete suicide for the U.S.," said Senator Arthur Vandenberg, Republican, of Michigan, in a statement to the *American Aviation Daily*.

"There will be a clamour if all lines are permitted to enter the field for profitable routes such as the North Atlantic. Where there is little trade there will be little desire to establish a route. This situation could easily invite air subsidies. If it is humanly possible, we must totally avoid the subsidy idea," the Senator concluded.

B.O.A.C. RESULTS

EXPANSION in every branch of the British Overseas Airways Corporation activities is shown in the provisional operational figures for 1944.

Total mileage at nearly 19,000,000, equal to a daily average of 51,000, and the number of passengers at 101,000, both showed increases of about 50 per cent. over the 1943 figures. Mileage since the war began is 57 millions.

Over 50,000 miles of routes are operated. They include two Atlantic services, one by flying-boats and the other by landplanes. The latter is in its fourth winter of operations, and is the only air service to have operated in both directions over the North Atlantic through four winters.

There are services to Stockholm, Lisbon, Madrid, to North Africa and West Africa, to Egypt and South Africa, and the 13,000 miles regular service via India to Australia, which is the longest civil air route in the world.

A network of services radiates from Cairo to Turkey, Persia, Abyssinia and other countries, which may not be made public for security reasons.

CANADA–U.S. AGREEMENTS

DETAILS of air agreements between Canada and the U.S.A. regarding military air transport routes and civil air routes were announced by the Prime Minister of Canada.

The military agreement replaces, for the duration of the war, the special arrangements now in force, and is subject to termination at any time on six months' notice from either Government. It provides for the full use of facilities over present routes; but all rights acquired by the two Governments will terminate with the end of the war.

The agreement on civil air-routes gives the U.S. four new routes into Canada, and Canada six new routes, including Alaska, into the U.S.A.

The new Canadian routes are: Halifax (Nova Scotia) to Boston (Mass.); Toronto to Cleveland, Ohio; Toronto to Chicago; Port Arthur, Ontario, to Duluth, Minn.; Victoria, B.C., to Seattle, Wash.; Whitehorse, Yukon, to Fairbanks, Alaska.

The U.S.A. will operate the following new lines over Canadian territory: New York or Boston to Quebec; New York to Ottawa; Washington to Montreal and Ottawa; Seattle to Whitehorse.

The Hon. C. D. Howe, Canadian Minister of Reconstruction, reviewing Canada's air position in a speech at Toronto Canadian Club, referred to Canada's interest in a North Atlantic route, a West Indies and North American route and in transportation over a Pacific route, and added that the R.C.A.F. is operating mail-passenger services to the U.K. and all Canadian fighting fronts.

"Every country in the world to-day intends to have a part in world aviation," he concluded. "Canada intends to play a leading part. We are building aircraft for the purpose which we believe are unsurpassed by those of competitor countries."

AIRFIELD OWNERS' PLAN—

EVERY city and town in Great Britain should have its airdrome, planned to meet its needs and as close as possible to its centre of population, says a memorandum by the Aerodrome Owners' Association submitted to Lord Swinton.

The association proposes that a comprehensive scheme should be prepared, and that for this purpose an advisory council on aviation should be set up to assist the Minister of Civil Aviation.

There should be no monopoly for a single company, either on internal or external air lines.

The present policy of ownership of civil airdromes should continue, and Government-owned civil airdromes should be operated by a statutory body.

A permanent airports board should be established to co-ordinate the planning, licensing and technical airdrome services.

Commenting on the Air Ministry booklet "The Technical Characteristics of Aerodromes," the association expresses the opinion that "the recommendations in the booklet are so extreme that if issued finally in anything like its present form it will tend to frighten present owners from developing their airdromes.

—PROTEST

THE meeting of the Aerodrome Owners' Association sent the following telegram addressed to the Prime Minister and the Minister of Civil Aviation:—

"This Annual General Meeting of the Aerodrome Owners' Association, comprising all the municipal and commercial owners of airdromes of Great Britain, having read in the Press this morning that Britain's air services are to be operated by an all-in holding company composed of British Overseas Airways, railways and shipping organisations, and that independent air enterprises will not be allowed to run services, adopted a unanimous resolution expressing the strongest opposition to this policy, and desire to inform His Majesty's Government that the members of the association collectively and independently will take all possible action to oppose the reported policy, which amounts to nothing less than a monopoly of British Air Transport."

—AND DINE

ADDRESSING members of the Aerodrome Owners' Association at a dinner at the Dorchester, marking the conclusion of their annual meeting, Lord Swinton said that the Government regarded no one as having a vested interest in air transport, except the travelling public. This interest will be best served by "order in the air." Progress will be more effective and more lasting if we eliminate wasteful competition and all the ill-will which such competition can breed, he said. Lord Swinton then referred to Commonwealth co-operation which, he said, has become a living reality. A complete agreement has been reached of how we are to run our service in partnership together, he stated.

Referring to post-war airfields, the Minister said that the desire to turn them into a re- re-insurance would lead to a size no one could afford. Safety is, of course, the prime consideration, but it is more dependent on the skill of aircraft manufacturers than on the length of runways. He urged for the co-operation of airfield owners with aircraft manufacturers, designers, technicians, etc.

The Chairman of this Association, Councillor Rhodes W. Marshall, hoped that the Civil Aviation Ministry will help to make the British public more air-minded. A monopoly of air transport would make the runways empty. If there is no competition, he said, internal transport will not exist.

Major H. R. Kilner, M.C., President of the S.B.A.C., said that only recently designers in this country were free to devote part of their attention to civil aircraft. He doubted the usefulness in this war of military designs still now on drawing boards. As to civil aircraft, should it prove, he said, that types between 80,000 and 100,000 pounds are required, this country will have none to offer, while in the States they have three such types off the drawing board, either flying or in production. Best transport aircraft, he added, can be produced only on the basis of team work between operators and designers.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

ABOUT AMPHIBIANS

Flying Boat or Seaplane?

WHILST getting over the difficulty I mentioned in *Flight*, February 1st, Mr. Woodward (*Flight*, February 15th) has made the arrangement twice as complicated and getting on for twice as inefficient as a flying-boat amphibian. I would suggest that he makes a sketch of the layout—I have!

In any case, Mr. Woodward missed the main point in my criticism, which was that an amphibious seaplane would be structurally and aerodynamically more inefficient than an amphibious flying boat.

P. R. PAYNE.

JET PROPULSION

Monatomic and Diatomic Gases

IN the article "Jet Propulsion," by K. G. Attkins (*Flight*, February 15th), the following statement appears: "We use such a gas (i.e., the monatomic type) because a high ratio of specific heat at constant volume to specific heat at constant pressure can be obtained."

I was under the impression that this ratio is lower for monatomic gases than for any other type of gas, the actual value being:—

$$\frac{\text{Specific heat at constant volume}}{\text{Spec. heat at constant pressure}} = 0.6,$$

the next lowest value being, for diatomic gases, 0.71.

Standard textbooks confirm my impression.

S. E. CANNING.

A CIVIL POWER-PLANT

About Maintenance and Feathering

I SHOULD like O. M. Etoe to furnish a three-view sketch on his proposals. Assuming he sticks to his Merlin, would he show us how—

(i) he would fit a set of inlet plugs?
(ii) fit a new priming system or clean the atomisers in the induction trunk?
(iii) change a magneto?
(iv) set the inlet tappet clearances?
(v) change the A.B.C. aneroid or adjust the linkwork between the control standards and carburettor?
(vi) adjust the mixture and altitude or power jets on the S.U. carb.?
(vii) remove the tachometer drive or B.T.H. compressor?

From his sketch in your February 15th issue the mainplane is presenting difficulties amounting to the "inlet-side" of the engine being about 16in. below the upper-wing surface.

Since the pay of mechanics may well be "on the hour" principle, isn't the cost of a minor inspection going to rise above that of a similar operation on the Lancastrian?

Before I close I should like to add: the idea looks nice, but, assuming the main spar to lie 30-40 per cent. of the chord back, the difficulties arising from simple maintenance begin to become frightening. Being a bit of a pilot, would he also tell me how a chap would see a Glycol leak from "B" bank port developing into a fire, so as to be able to feather and prevent "passenger stampede"? Quick feathering is essential.

L. ARTHUR (Flt. Lt., R.A.F.).

"SHIPRAILAIR"

How Much Per Passenger Mile?

IN connection with the railways' plan for internal air services as set out in the Rail-Air Plan, a separate announcement suggested that the fare should be 4½d. a passenger-mile.

This amount is approximately 50 per cent. greater than the prevailing fare in either Canada or the United States, even on the shortest routes. It represents a greater spread between the prevailing first-class train fare in England and the proposed fare for air travel than the spread between the first-class train fare and the aircraft fare in America.

In America there is expected to be a great rivalry between first-class rail travel and air travel. In England it would seem that the railways are very keen to develop air travel, but at a price that would not compete with their rail passenger traffic.

While this is only natural, it is definitely an argument against allowing the railways to dominate the aviation picture. This traffic should be developed on the basis of 3d. a passenger-mile. The fare to Liverpool one way would be approximately £2 10s. or £2 16s. including taxis at each end as is the usual American custom.

Mr. Farey Jones states in the debate "that any single journey which the average air passenger would take would involve at some part of the distance between his home and his destination the use of a bus, a train or a ship." I have made several trips by air in Canada and only travelled by aircraft and in a taxi at each end of the flight. On some occasions the train might be used for a journey to some local point, but this is such an insignificant part of the whole trip that it would be hardly reasonable to base the case for the railways and shipping for a share in the aviation picture on such specious grounds.

F. N. A. ROWELL.

CARGO AIRCRAFT

Horace's "Very Remarkable Statement"

I HAVE just read Horace's remarks (*Flight*, February 8th) about gliders and their impracticability as regards use for post-war freight carriers.

Having flown them quite a bit, I should like to add my entire agreement with his remarks except for one very remarkable statement.

Really, Horace, you don't expect me to believe that a single-engined fighter will tow a Horsa with thirty bodies and two pilots and all the paraphernalia that necessarily follows an Army body about? Quite frankly I just don't believe it. On top of that, a small fighter having a payload alone of some 7,500 lb. on the other end of the string, plus, I think, another 9,000 lb. (correct me if I'm wrong) weight of Horsa, would produce a most unpleasant set of conditions for the tug pilot, especially if the glider pilot didn't like him.

However, if it has ever been done, will somebody please tell me, because it rather interests me.

V. A. STANLEY-ADAMS (Lt., R.A.).

IMPLICATIONS OF V2

Counter-gravity of the Moon

"ESCAPIST'S" ideas *re* the variation of V_{Lib} (which I shall call U henceforth) are substantially correct, but the value does not fall off quite so rapidly as he supposes. At the same time, Messrs. Gatland and Burgess appear to apply the surface value of U at all practical heights, and also to ignore the favourable counter-gravity of the moon. The following values obtain:

Surface — U<11.99 km/sec.
100 km. up — U<11.00 km/sec.
500 km. up — U<10.19 km/sec.
(ignoring moon effect).

At the latter height, the moon effect, for example, reduces U to 9.74 km/sec. This leaves scope for a wide range of accelerations if jet efficiency is not a deciding factor.

As regards "orbital" velocity, this depends (as U does not) on the ratio of the mass of the projectile to the mass of the earth. A permissible simplification of Keple's 3rd Law is

$$\frac{m}{M} = \left(\frac{a}{A}\right)^3 \left(\frac{t}{T}\right)^2$$

where m, M are respective masses; a, A, respective radii of orbit; t, T, respective orbital periods.

Thus the ratio of the masses affects the result.

To raise another question, for a given V — U (where V = max. velocity of rocket) there must be a "critical cone" whose axis is along the line joining the earth and moon, and apex at the launching point, such that if the rocket "strayed" outside it, the rocket would never reach the moon. If your columns could spare the space, it would be interesting to hear the views of Messrs. Gatland and Burgess on the dimensions of such a cone, and its variation with variations of V — U. Can there be a range of values of V — U in which the rocket, if poorly aimed, would fall on the far side of the moon?

STUDENT.

OLD-TIMER: Ground crews camouflage a Hurribomber at dispersal. Hawker Hurricanes are still doing good work supporting the 14th Army.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News and Announcements

Promotions

GENERAL DUTIES BRANCH.

THE following Air Vice-Marshals are granted the acting rank of Air Marshal:—C. E. H. MEDHURST, C.B., O.B.E., M.C, Feb. 8th, 1945; The Hon. Sir RALPH A. COCHRANE, K.B.E., C.B., A.F.C. Feb. 15th, 1945.

Awards

Fleet Air Arm

THE KING has been graciously pleased to approve the following awards for distinguished service in air operations in the Mediterranean:—

Distinguished Service Cross

Sub. Lt. (A) D. A. DAVIES, R.N.V.R.
Sub. Lt. (A) L. P. DUNNE, R.N.V.R.
Sub. Lt. (A) C. R. NEVILLE, R.N.V.R.

Bar to Distinguished Service Medal

Temp. A/G. R. A. DIXON.

Distinguished Service Medal

L/A. S. DRISCOLL.

THE KING has been graciously pleased to approve the following award for gallantry in firefighting when an aircraft crashed and burst into flames although he knew that a bomb on board might explode at any time:—

B.E.M. (Mil.)

Air Fitter (L) C. A. MORVAN.

Royal Air Force

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

Third Bar to Distinguished Service Order

Wing Cdr. J. B. TAIT, D.S.O., D.F.C., R.A.F., No. 617 Sqn.—This officer has displayed conspicuous bravery and extreme devotion to duty in the face of the enemy, constantly exemplified over a long period of operational flying. He has completed a very large number of sorties, many of them against most dangerous and difficult targets, and the successes obtained are a magnificent tribute to his brilliant leadership and unsurpassed skill. On three occasions Wing Cdr. Tait has led attacks on the German battleship *Tirpitz*. The last occasion was on November 12th, 1944. The vessel was laying at Tromso. Visibility was good as Wing Cdr. Tait led his squadron in to the attack. In spite of continuous fire from three ships and from land batteries, the attack was pressed home. The first bomb, dropped by Wing Cdr. Tait, hit the *Tirpitz*. Another hit was obtained almost immediately and another 12,000lb. bomb fell close alongside. The battleship caught fire and smoke poured from her. Finally, she capsized. By his outstanding skill and leadership, Wing Cdr. Tait played a prominent part in the success of the operation. This officer has completed 98 sorties and throughout has set an example of a high order.

Air Comdre. C. A. Bouchier, C.B.E., D.F.C., who produced the air support plan for D-day. Security was so vital that Air Comdre Bouchier himself worked the duplicating machine with which the plan was reproduced.

Distinguished Service Order

Wing Cdr. H. A. C. BIRD-WILSON, D.F.C., R.A.F.O.—Since being awarded a Bar to the D.F.C. this officer has participated in a very large number of sorties. He has continued to display the highest qualities of leadership, skill and gallantry, qualities which have been well illustrated in the fine fighting spirit of the squadron he commands. Within the past four months, Wing Cdr. Bird-Wilson has led large formations of aircraft on a variety of sorties during which much success has been obtained. Many enemy aircraft have been destroyed, whilst a good number of locomotives, wagons, mechanical transport and armoured fighting vehicles have been most effectively attacked. Throughout these operations, Wing Cdr. Bird-Wilson has set an example which has inspired all.

Act. Wing Cdr. T. E. ISON, D.F.C., R.A.F., No. 156 Sqn.—This officer has completed many sorties against dangerous and difficult targets since being awarded the D.F.C. He has consistently displayed the highest qualities of skill and courage and his determination to make every sortie a success has won great praise. In September, 1944, he flew with great distinction in an attack on Gelsenkirchen. His aircraft was hit several times by anti-aircraft fire, but he pressed home a successful attack. In November, 1944, Wing Cdr. Ison took part in an attack against Freiburg. The weather was bad. Nevertheless, this officer displayed the greatest determination throughout the operation, and his skilful work contributed materially to the success of the mission. Wing Cdr. Ison has set a fine example to all.

P/O. A. J. COCKERILL, R.A.A.F., No. 462 (R.A.A.F.) Sqn.—One night in October, 1944, this officer was pilot and captain of an aircraft detailed to attack Duisburg. When nearing the target the aircraft was illuminated in the searchlights and subjected to much anti-aircraft fire. A fragment of shrapnel, which tore through the

SERVICE AVIATION

windscreen, struck P/O. Cockerill in the eye. The wound was severe, he momentarily lost consciousness, and the aircraft went into a dive. P/O. Cockerill recovered in time to level out and went on to complete the bombing run. The aircraft was still illuminated by the searchlights as he turned for home. Although weak from shock and loss of blood and in great physical distress, this brave pilot remained at the controls. He was unable to see his instruments, but his air bomber stood by to give the necessary instructions. So assisted, P/O. Cockerill flew the aircraft to an airfield in this country. Calling upon his last remaining strength, he landed safely. By his skill, courage and fortitude this officer set an example of the highest order.

Bar to Distinguished Flying Cross

Sqn. Ldr. R. BANNOCK, D.F.C., R.C.A.F., No. 418 (R.C.A.F.) Sqn.—This officer has displayed outstanding ability, great determination and devotion to duty. Within recent months he has completed a number of sorties against air fields, some of them far into enemy territory. His sterling qualities were well evidenced one night in September, 1944, during an attack on an enemy airfield. Over the target, Sqn. Ldr. Bannock shot down two enemy aircraft. In the second of the fights his own aircraft was damaged by flying debris. One engine failed but he flew his aircraft several hundred miles back to base where he effected a safe landing.

Act. Sqn. Ldr. A. C. NORMAN, D.F.C., R.A.F.V.R., No. 644 Sqn.—This officer has completed many operational missions since being awarded the D.F.C., and has consistently displayed gallantry and devotion to duty of a high order. He is a forceful and inspiring leader, whose keenness and strong sense of duty have set an example worthy of high praise.

Act. Sqn. Ldr. L. W. H. WELCH, D.F.C., R.A.F.V.R., No. 605 Sqn.—Sqn. Ldr. Welch has completed much operational flying. He has set a splendid example of skill, keenness and gallantry and has shown the utmost devotion to duty. In October, 1944, he participated in an attack on an airfield in Austria. In spite of intense anti-aircraft fire, Sqn. Ldr. Welch was responsible for the destruction of two enemy aircraft. His own aircraft was hit, but he flew safely to base, despite fighter interference on the homeward flight. On this notable sortie Sqn. Ldr. Welch displayed exceptional skill and resolution.

Flt. Lt. D. WELFARE, D.F.C., R.A.F.V.R., No. 239 Sqn., and F/O. D. B. BELLIS, D.F.C., R.A.F.V.R., No. 239 Sqn.—These officers have participated in a very large number of sorties in the capacity of pilot and observer respectively. They have shown the highest qualities of keenness and devotion to duty and have set a very fine example. They have destroyed eight enemy aircraft, successes which are a fine tribute to their great skill and fighting spirit.

Act. Wing Cdr. W. L. BRILL, D.S.O., D.F.C., R.A.A.F., No. 467 (R.A.A.F.) Sqn.—Since his previous award, Wing Cdr. Brill has completed many successful sorties. His fine leadership, undaunted courage and tactical ability are worthy of the highest commendation. When participating in an attack against St. Lou d'Essorent, his aircraft was attacked on three occasions by enemy fighters. By his skilful airmanship he drove off the attackers and, despite damage, flew his aircraft safely back to base. Another time in August, 1944, during an attack against Konigsberg, Wing Cdr. Brill obtained an excellent photograph.

F/O. I. B. MCPHERSON, D.F.C., R.A.F.V.R., No 105 Sqn.—Since the award of the D.F.C., F/O. McPherson has completed numerous sorties. Throughout all his operations he has consistently displayed exemplary courage and tenacity of purpose, which, together with his outstanding skill and fine leadership, are worthy of high praise.

Distinguished Flying Cross

F/O. A. GEORGE, R.A.F.V.R., No. 50 Sqn.
F/O. A. C. GORDON, R.A.F., No. 218 Sqn.
F/O. T. G. GREENE, R.A.F.V.R., No. 156 Sqn.
F/O. B. GRIFFITHS, R.A.F., No. 9 Sqn.
F/O. G. O. GURNEY, R.A.F.V.R., No. 427 (R.C.A.F.) Sqn.
F/O. B. HAMILTON, R.A.F.V.R., No. 625 Sqn.
F/O. J. W. HATTON, R.A.F.V.R., No. 35 Sqn.
F/O. K. J. HAWKINS, R.A.F.V.R., No. 214 Sqn.
F/O. P. S. HOBBS, R.A.F.V.R., No. 608 Sqn.
F/O. J. C. HUTCHESON, R.A.F.V.R., No. 550 Sqn.
F/O. L. S. JAMES, R.A.F.V.R., No. 635 Sqn.
F/O. A. P. JONES, R.A.F.V.R., No. 626 Sqn.
F/O. P. B. KETTLE, R.A.F.V.R., No. 156 Sqn.
F/O. C. P. KNIGHT, R.A.F.V.R., No. 214 Sqn.
F/O. R. D. LAWSON, R.A.F.V.R., No. 431 (R.C.A.F.) Sqn.
F/O. W. G. F. LEWIS, R.A.F.V.R., No. 640 Sqn
F/O. R. F. LEWIS, R.A.F.V.R., No. 9 Sqn.
F/O. G. LOFTHOUSE, R.A.F.V.R., No. 626 Sqn.
F/O. J. LORD, R.A.F.V.R., No. 550 Sqn.
F/O. M. R. LOVELL, R.A.F.V.R., No. 78 Sqn.
F/O. C. J. LYWOOD, R.A.F.V.R., No. 102 Sqn.
F/O. A. MACKINNON, R.A.F.V.R., No. 692 Sqn.
F/O. D. R. MALLINSON, R.A.F.V.R., No. 630 Sqn.
F/O. J. MASON, R.A.F.V.R., No. 166 Sqn.
F/O. G. F. MAULE, R.A.F.V.R., No. 9 Sqn.
F/O. A. MCCRACKEN, R.A.F.V.R., No. 97 Sqn.
F/O. R. MCK. MINNIS, R.A.F.V.R., No. 625 Sqn.
F/O. S. A. MORRIS, R.A.F.V.R., No. 9 Sqn.
F/O. W. S. MOUNTFORD, R.A.F.V.R., No. 35 Sqn.
F/O. E. R. OLIVER, R.A.F.V.R., No. 50 Sqn.
F/O. S. G. PICKARD, R.A.F.V.R., No. 7 Sqn.
F/O. L. D. POPE, R.A.F., No. 35 Sqn.
F/O. H. E. RAWLIN, R.A.F.V.R., No. 214 Sqn.
F/O. K. ROBINSON, R.A.F.V.R., No. 10 Sqn.
F/O. R. P. SCULTHORPE, R.A.F.V.R., No. 43 (R.C.A.F.) Sqn.
F/O. W. SEARSTON, R.A.F.V.R., No. 115 Sqn.
F/O. H. O. SHARMAN, R.A.F.V.R., No. 161 Sqn.
F/O. K. M. SHAW-BROWN, R.A.F.V.R., No. 433 (R.C.A.F.) Sqn.
F/O. S. A. SHEPPARD, R.A.F.V.R., No. 100 Sqn.
F/O. F. H. STANTON, R.A.F.V.R., No. 7 Sqn.
F/O. H. S. S. TROTTER, R.A.F.V.R., No. 12 Sqn.
F/O. J. J. H. TWYNAM, R.A.F.V.R., No. 515 Sqn.
F/O. T. H. UFTON, R.A.F.V.R., No. 214 Sqn.
F/O. A. WATSON, R.A.F.V.R., No. 156 Sqn.
F/O. K. WIELIAMS, R.A.F.V.R., No. 78 Sqn.
F/O. G. M. WRIGHT, R.A.F.V.R., No. 101 Sqn.
Act. F/O. J. H. ALLEN, R.A.F.V.R., No. 578 Sqn.
Act. F/O. J. R. HENDRY, R.A.F.V.R., No. 90 Sqn.
Act. F/O. R. J. HOPES, R.A.F.V.R., No. 101 Sqn.
Act. F/O. K. JURY, R.A.F.V.R., No. 77 Sqn.
Act. F/O. E. C. REDFERN, R.A.F.V.R., No. 9 Sqn.
Act. F/O. G. M. REID, R.A.F., No. 578 Sqn.
Act. F/O. A. P. SIMS, R.A.F.V.R., No. 625 Sqn.
Act. F/O. M. A. SWAIN, R.A.F.V.R., No. 630 Sqn.
Act. F/O. B. TAYLOR, R.A.F.V.R., No. 9 Sqn.
Act. F/O. J. H. THORPE, R.A.F.V.R., No. 35 Sqn.
P/O. D. BEAUMONT, R.A.F.V.R., No. 635 Sqn.
P/O. K. D. BROWN, R.A.F.V.R., No. 635 Sqn.
P/O. J. W. CHADWICK, R.A.F.V.R., No. 43 (R.C.A.F.) Sqn.
P/O. M. CLEGG, R.A.F.V.R., No. 578 Sqn.
P/O. J. C. COUPER, R.A.F.V.R., No. 578 Sqn.
P/O. E. J. DAVIES, R.A.F.V.R., No. 51 Sqn.
P/O. K. T. DENLEY, R.A.F.V.R., No. 7 Sqn.
P/O. J. L. DISHINGTON, R.A.F.V.R., No. 101 Sqn.
P/O. C. J. DUDLEY, R.A.F.V.R., No. 578 Sqn.
P/O. P. A. GREENAWAY, R.A.F.V.R., No. 7 Sqn.
P/O. S. R. J. HARPER, R.A.F.V.R., No. 635 Sqn.
P/O. R. C. HAYES, R.A.F.V.R., No. 466 (R.A.A.F) Sqn.
P/O. E. F. HEARN, R.A.F.V.R., No. 156 Sqn.
P/O. N. HEBDEN, R.A.F.V.R., No. 608 Sqn.
P/O. D. B. J. HICKS, R.A.F.V.R., No. 582 Sqn.
P/O. J. HILL, R.A.F.V.R., No. 619 Sqn.
P/O. A. S. JONES, R.A.F.V.R., No. 51 Sqn.
P/O. F. T. KEIGHTLEY, R.A.F.V.R., No. 640 Sqn
P/O. M. W. KENNY, R.A.F.V.R., No. 7 Sqn.
P/O. D. E. KING, R.A.F.V.R., No. 405 (R.C.A.F.) Sqn.
P/O. G. E. LEWIS, R.A.F.V.R., No. 7 Sqn.
P/O. D. LONGTON, R.A.F.V.R., No. 578 Sqn
P/O. P. W. B. MANN, R.A.F.V.R., No. 12 Sqn.
P/O. J. R. MOORE, R.A.F.V.R., No. 578 Sqn.
P/O. A. H. MULLARD, R.A.F.V.R., No. 635 Sqn
P/O. F. OLIVER, R.A.F.V.R., No. 156 Sqn.
P/O. H. PARKER, R.A.F.V.R., No. 635 Sqn.
P/O. B. G. PAYNE, R.A.F.V.R., No. 7 Sqn.
P/O. N. M. PHILLIPS, R.A.F.V.R., No. 578 Sqn.
P/O. C. SKILLAW, R.A.F.V.R., No. 57 Sqn.
P/O. B. S. SKINNER, R.A.F.V.R., No. 692 Sqn.
P/O. S. SMITH, R.A.F.V.R., No. 434 (R.C.A.F.) Sqn.
P/O. J. N. STEEL, R.A.F.V.R., No. 635 Sqn.
P/O. D. SWAFFIELD, R.A.F.V.R., No. 635 Sqn.
P/O. R. TOWNSEND, R.A.F.V.R., No. 578 Sqn.
P/O. H. WATSON, R.A.F.V.R., No. 12 Sqn.
P/O. A. WATTS, R.A.F.V.R., No. 7 Sqn.
P/O. C. E. WILKIN, R.A.F.V.R., No. 7 Sqn.
P/O. C. D. WILSON, R.A.F.V.R., No. 578 Sqn.
W/O. V. E. AZZARO, R.A.F.V.R., No. 7 Sqn.
W/O. A. J. BIRCH, R.A.F.V.R., No. 77 Sqn.
W/O. M. J. BULLED, R.A.F.V.R., No. 7 Sqn.
W/O. E. G. CANELLE, R.A.F.V.R., No. 102 Sqn.
W/O. G. A. CARVELL, R.A.F.V.R., No. 97 Sqn.
W/O. J. M. COULSON, R.A.F.V.R., No. 156 Sqn.
W/O. J. EGAN, R.A.F.V.R., No. 156 Sqn.
W/O. J. E. FOLEY, R.A.F.V.R., No. 608 Sqn.
F/O. L. J. NOTLEY, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
F/O. K. B. PETHERICK, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
F/O. S. A. SEMPLE, R.A.A.F., No. 467 (R.A.A.F.) Sqn.
F/O. F. M. J. STEVENS, R.A.A.F., No. 90 Sqn.
F/O. J. G. SUTHERLAND, R.A.A.F., No. 155 Sqn.
F/O. R. G. WATTS, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
Act. F/O. G. M. DENHOLM, R.A.A.F., No. 463 (R.A.A.F.) Sqn.
Act. F/O. R. B. PATTISON, R.A.A.F., No. 625 Sqn.
P/O. R. E. ABELL, R.A.A.F., No. 51 Sqn.
P/O. A. W. ADAMS, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. W. D. COLLETT, R.A.A.F., No. 78 Sqn.
P/O. N. L. D. DALBY, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. A. L. FAULKNER, R.A.A.F., No. 51 Sqn.
P/O. K. MCKNIGHT, R.A.A.F., No. 51 Sqn.
P/O. K. J. STANTON, R.A.A.F., No. 7 Sqn.
P/O. L. V. TARDENT, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. R. TOMLINSON, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
P/O. R. S. TROY, R.A.A.F., No. 635 Sqn.
P/O. D. MCL. WHITESIDE, R.A.A.F., No. 186 Sqn.
P/O. K. H. YOUDALE, R.A.A.F., No. 619 Sqn.
F/O. W. F. MARTIN, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
F/O. G. T. MCKEAN, R.C.A.F., No. 415 (R.C.A.F.) Sqn.
F/O. D. A. MCNAUGHTON, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
F/O. J. D. R. NIXON, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
F/O J. C. P. O'CONNOR, R.C.A.F., No. 101 Sqn.
F/O. V. F. PAINTER, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
F/O. W. PALIDWAR, R.C.A.F., No. 42 (R.C.A.F.) Sqn.
F/O. W. P. PATERSON, R.C.A.F., No. 424 (R.C.A.F.) Sqn.
F/O S. R. PRICE, R.C.A.F., No. 429 (R.C.A.F.) Sqn.
F/O. J. REEKIE, R.C.A.F., No. 405 (R.C.A.F.) Sqn.

FIGHTER SCREEN : A Typhoon of Second T.A.F. taxies through a pool of water before taking off for Germany, to deliver its two 1,000-pounders.

F/O. J. A. RICHARDSON, R.C.A.F., No. 42 (R.C.A.F.) Sqn.
Act. Sqn. Ldr. S. W. GOOCH, R.A.F.V.R., No. 58 Sqn.
Flt. Lt. H. W. BURROUGHS, R.A.F.V.R., No. 58 Sqn.
Flt. Lt. J. CAPEY, R.A.F.V.R., No. 502 Sqn.
Flt. Lt. G. L. CONNER, R.A.F.V.R., No. 58 Sqn.
Flt. Lt. D. C. FAIRBANKS, R.C.A.F., No. 274 Sqn.
Flt. Lt. C. E. LYE, R.N.Z.A.F., No. 214 Sqn.
Flt. Lt. W. G. POWELL, R.A.F.V.R., No. 502 Sqn.
Flt. Lt. D. H. PRUDEN, R.A.F.V.R., No. 502 Sqn.
Flt. Lt. J. S. SHIACH, R.C.A.F., No. 58 Sqn.
Act. Flt. Lt. F. J. RUSH, R.C.A.F., No. 502 Sqn.
P/O. J. P. LUCY, R.A.A.F., No. 502 Sqn.
F/O. J. W. SMITH, R.A.F., No. 515 Sqn.
W/O. S. D. JAMES, R.A.F.V.R., No. 209 Sqn.
F/O. E. E. WEST, R.C.A.F., No. 420 (R.C.A.F.) Sqn.
F/O. G. E. WILSON, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
F/O. F. A. WINN, R.C.A.F., No. 78 Sqn.
F/O. C. O. WUORI, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
Act. F/O. W. S. HALL, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
Act. F/O. W. C. MACNEIL, R.C.A.F., No. 415 (R.C.A.F.) Sqn.
Act. F/O. J. F. NEILANS, R.C.A.F., No. 424 (R.C.A.F.) Sqn.
Act. F/O. T. A. T. RHODES, R.C.A.F., No. 431 (R.C.A.F.) Sqn.
Act. F/O. A. W. WILLIAMS, R.C.A.F., No. 77 Sqn.
P/O. B. L. ALLARD, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. D. R. ANDREWS, R.C.A.F., No. 415 (R.C.A.F.) Sqn.
P/O. K. E. BARTLEMAN, R.C.A.F., No. 156 Sqn.
P/O. S. H. BODALY, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
P/O. E. W. C. BRACKETT, R.C.A.F., No. 156 Sqn.
P/O. H. BRITTON, R.C.A.F., No. 432 (R.C.A.F.) Sqn.
P/O. R. McN. CAMPBELL, R.C.A.F., No. 432 (R.C.A.F.) Sqn.
P/O. R. G. DONALD, R.C.A.F., No. 424 (R.C.A.F.) Sqn.
P/O. J. D. DONALDSON, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. I. R. R. ENOS, R.C.A..F, No. 245 (R.C.A.F.) Sqn.
P/O. F. H. EWING, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. J. A. TEASE, R.C.A.F., No. 420 (R.C.A.F.) Sqn.
P/O. L. THISTLE, R.C.A.F., No. 426 (R.C.A.F.) Sqn.
P/O. J. A. WADDELL, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
P/O. T. V. WILSHIRE, R.C.A.F., No. 427 (R.C.A.F.) Sqn.
P/O. C. A. YOUNG, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
W/O.2 (now P/O.) A. M. HOLMES, R.C.A.F., No. 9 Sqn.
W/O.2 T. C. K. WOOLF, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
W/O. W. G. YOUNG, R.C.A.F., No. 35 Sqn.
F/O. D. H. MAYCROFT, R.N.Z.A.F., No. 103 Sqn.
F/O. H. S. SCHWASS, R.N.Z.A.F., No. 166 Sqn.
P/O. J. BAINES, R.N.Z.A.F., No. 75 (N.Z.) Sqn.
P/O. K. A. DODMAN, R.N.Z.A.F., No. 571 Sqn.
P/O. F. A. GILL, R.C.A.F., No. 428 (R.C.A.F.) Sqn.

The Crest of No. 276 Sqn.—"Retrieve."

P/O. R. M. GOODMAN, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
P/O. D. A. GRANT, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
P/O. J. R. HURLY, R.C.A.F., No. 431 (R.C.A.F.) Sqn.
P/O. W. G. KEMP, R.C.A.F., No. 640 Sqn.
P/O. W. D. KEEN, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
P/O. R. E. MCWHIRTER, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. J. MAGILL, R.C.A.F., No. 578 Sqn.
P/O. H. F. MAGNUSSON, R.C.A.F., No. 427 (R.C.A.F.) Sqn.
P/O. J. W. MORRIS, R.C.A.F., No. 42 (R.C.A.F.) Sqn.
P/O. J. R. PEPIN, R.C.A.F., No. 425 (R.C.A.F.) Sqn.
P/O. P. M. POIRIER, R.C.A.F., No. 425 (R.C.A.F.) Sqn.
P/O. A. L. RICHARDSON, R.C.A.F., No. 415 (R.C.A.F.) Sqn.
P/O. D. E. RICHMOND, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
P/O. R. A. RUTHERGLEN, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
P/O. L. McI. TAGGART, R.C.A.F., No. 582 Sqn.
F/O. W. D. ROBERTSON, R.C.A.F., No. 550 Sqn.
F/O. C. H. SHERWOOD, R.C.A.F., No. 42 (R.C.A.F.) Sqn.
F/O. W. J. SHEPPARD, R.C.A.F., No. 9 Sqn.
F/O. W. G. SKEEIK, R.C.A.F., No. 429 (R.C.A.F.) Sqn.
F/O. C. R. SMITH, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
F/O. H. B. SNELGROVE, R.C.A.F., No. 550 Sqn.
F/O. W. P. SPEAK, R.C.A.F., No. 433 (R.C.A.F.) Sqn.
F/O. J. W. STEELS, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
F/O. G. R. STUNDAN, R.C.A.F., No. 43 (R.C.A.F.) Sqn.
F/O. J. E. TAYLOR, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
F/O. W. J. TAYLOR, R.C.A.F., No. 426 (R.C.A.F.) Sqn.
F/O. J. A. C. TROTTIER, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
F/O. M. J. TULLY, R.C.A.F., No. 408 (R.C.A.F.) Sqn.
F/O. H. VINCENT, R.C.A.F., No. 42 (R.C.A.F.) Sqn.
F/O. J. M. C. WADE, R.C.A.F., No. 429 (R.C.A.F.) Sqn.
Wing Cdr. A. BARKER, R.C.A.F., No. 418 (R.C.A.F.) Sqn.
Act. Sqn. Ldr. R. G. GRAY, R.C.A.F., No. 418 (R.C.A.F.) Sqn.
Act. Sqn. Ldr. R. J. IMBER, R.A.F.V.R., No. 298 Sqn.
Flt. Lt. S. C. ASKEW, R.A.F.V.R., No. 196 Sqn.
Flt. Lt. D. L. BADLEY, R.N.Z.A.F., No. 23 Sqn.
Flt. Lt. T. A. BURKE, R.A.F.V.R., No. 602 Sqn.
Flt. Lt. B. G. DUCKETT, R.A.F.V.R., No. 85 Sqn.
F/O. A. J. ARNOLD, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
F/O. R. F. BUNCE, R.A.F.V.R., No. 620 Sqn.
F/O. V. R. GLOVER, R.C.A.F., No. 420 (R.C.A.F.) Sqn.
F/O. D. H. HARDWICK, R.A.F.V.R., No. 299 Sqn.
F/O. A. JOHNSON, R.A.F.V.R., No. 298 Sqn.
F/O. R. E. LELONG, R.N.Z.A.F., No. 605 Sqn.
P/O. J. A. MCLAREN, R.A.F.V.R., No. 605 Sqn.
F/O. J. D. MCLAREN, R.A.F., No. 298 Sqn.

FOR BLAST EFFECT: Typhoons supporting the Cleve offensive employed a new type of close-support bomb, consisting of a canister containing twenty-six 20-lb. anti-personnel bombs. These bombs are extremely effective where cover is scarce.

SERVICE

F/O. K. G. ORMAN, R.N.Z.A.F., No. 186 Sqn.
F/O. E. F. RAMPLING, R.A.F.V.R., No. 644 Sqn.
F/O. A. TURNBULL, R.A.F.V.R., No. 644 Sqn.
P/O. T. R. M. JOHNSON, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
P/O. R. G. MANSFIELD, R.C.A.F., No. 419 (R.C.A.F.) Sqn.
P/O. C. R. OLSON, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
P/O. G. W. A. PEARCE, R.C.A.F., No. 428 (R.C.A.F.) Sqn.
P/O. M. F. SANDERS, R.A.A.F., No. 419 (R.C.A.F.) Sqn.
Ft. Lt. A. J. CRAVEN, R.A.F.V.R., No. 605 Sqn.
Flt. Lt. T. ARMSTRONG, R.A.F.V.R., No. 235 Sqn.
Flt. Lt. E. W. WATSON, R.A.A.F., No. 455 (R.A.A.F.) Sqn.
Flt. Lt. W. H. MCCAMUS, R.C.A.F., No. 404 (R.C.A.F.) Sqn.
F/O. L. C. BOILEAU, R.C.A.F., No. 404 (R.C.A.F.) Sqn.
W/O. L. A. COMPTON, R.A.F., No. 248 Sqn.
W/O. G. A. MACASKILL, R.A.F.V.R., No. 248 Sqn.
W/O. A. D. ROWE, R.A.F.V.R., No. 73 Sqn.
F/O. M. J. FROST, R.A.F.V.R., No. 206 Sqn.
F/O. E. GLOVER, R.A.F.V.R., No. 47 Sqn.
F/O. L. C. HALL, D.F.M., R.A.F.V.R., No. 161 Sqn.
F/O. H. L. INNISS, R.A.F.V.R., No. 61 Sqn.
F/O. A. R. KERR, R.A.F.V.R., No. 630 Sqn.
F/O. R. J. KING, R.A.F.V.R., No. 61 Sqn.
F/O. J. LONGBOTHAM, R.A.F.V.R., No. 12 Sqn.
F/O. B. P. A. MOSE, R.A.F.V.R., No. 433 (R.C.A.F.) Sqn.
F/O. S. MOSS, R.A.F.V.R., No. 75 (N.Z.) Sqn.
F/O. D. R. PRESTON, R.A.F.V.R., No. 51 Sqn.
F/O. G. A. PRICE, R.A.F.V.R., No. 626 Sqn.
F/O. C. H. SHEPHERD, D.F.M., R.A.F.V.R., No. 9 Sqn.
Act. F/O. W. MCC. FERGUSON, R.A.V.R., No. 15 Sqn.
Act. F/O. E. P. MITCHELL, R.A.F.V.R., No. 630 Sqn.
Act. F/O. P. V. T. RIBBINS, R.A.F.V.R., No. 100 Sqn.
P/O. P. M. ABBOTT, R.A.F.V.R., No. 49 Sqn.
P/O. R. GRAIG, R.A.F.V.R., No. 514 Sqn.
P/O. C. DEAN, R.A.F.V.R., No. 467 (R.A.A.F.) Sqn.
P/O. W. HARVEY, R.A.F.V.R., No. 97 Sqn.
P/O. M. F. INGMIRE, R.A.F.V.R., No. 83 Sqn.
P/O. N. JENNINGS, R.A.F.V.R., No. 514 Sqn.
P/O. B. F. KENT, R.A.F.V.R., No. 467 (R.A.A.F.) Sqn.
P/O. R. PAYNE, R.A.F.V.R., No. 434 (R.C.A.F.) Sqn.
P/O. J. PLOWRIGHT, R.A.F.V.R., No. 77 Sqn.
P/O. W. T. POOLE, R.A.F.V.R., No. 15 Sqn.
P/O. R. PRATT, R.A.F.V.R., No. 640 Sqn.
P/O. J. B. A. SCANNELL, D.F.M., R.A.F.V.R., No. 405 (R.C.A.F.) Sqn.
P/O. G. L. SMITH, R.A.F.V.R., No. 51 Sqn.
P/O. F. A. WELLS, R.A.F.V.R., No. 44 Sqn.
W/O. R. BELSHAW, R.A.F.V.R., No. 156 Sqn.
W/O. G. O. EDMUNDS, R.A.F.V.R., No. 97 Sqn.
W/O. M. E. MACDONALD, R.A.F.V.R., No. 106 Sqn.
F/O. B. K. PURDY, R.A.A.F., No. 465 (R.A.A.F.) Sqn.
F/O. H. R. PURSER, R.A.A.F., No. 467 (R.A.A.F.) Sqn.
F/O. N. RATTEN, D.F.M., R.A.A.F., No. 465 (R.A.A.F.) Sqn.
F/O. R. P. ROBERTS, R.A.A.F., No. 35 Sqn.
F/O. N. E. TWYFORD, R.A.A.F., No. 460 (R.A.A.F.) Sqn.
Act. F/O. C. J. WOOLNOUGH, R.A.A.F., No. 97 Sqn.
P/O. H. J. ERB, R.A.A.F., No. 467 (R.A.A.F.) Sqn.
P/O. E. W. WEAVER, R.A.A.F., No. 467 (R.A.A.F.) Sqn.
F/O. J. S. MCDOWELL, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
F/O. N. W. MARSHALL, R.C.A.F., No. 425 (R.C.A.F.) Sqn.
F/O. B. E. MAWHINNEY, R.C.A.F., No. 431 (R.C.A.F.) Sqn.
F/O. R. G. SAMSON, R.C.A.F., No. 434 (R.C.A.F.) Sqn.
F/O. A. W. TINMOUTH, D.F.M., R.C.A.F., No. 415 Sqn.
F/O. E. D. WICKENS, R.C.A.F., No. 434 (R.C.A.F.) Sqn.
F/O. A. W. WINCH, R.C.A.F., No. 419 (R.C.A.F.) Sqn.

Conspicuous Gallantry Medal

Flt. Sgt. F. TOMKINS, R.A.F.V.R., No. 180 Sqn.—In December, 1944, this airman was the wireless operator in an aircraft detailed to attack a target in the Stralen area. During the sortie the aircraft was hit by anti-aircraft fire and sustained damage. The navigator and the pilot were wounded, the latter severely. Some Verey cartridges near the pilot were set alight. The cockpit became filled with smoke, which obscured most of the flying instruments. A small fire started amidships. Flt. Sgt. Tomkins saw that the navigator was dealing successfully with the fire, so he promptly crawled over the bomb bay to assist the injured pilot, who, by now, was in a state bordering on collapse. He rallied when succoured by Sgt. Tomkins, who afterwards took over the controls and flew the aircraft to an airfield in friendly territory. Here, under the instructions of his wounded pilot, he brought the aircraft down safely. In the face of most trying circumstances, Sgt. Tomkins displayed courage, coolness and resource of a high order.

Distinguished Flying Medal

Flt. Sgt. M. S. GOLLAN, R.N.Z.A.F., No. 206 Sqn.
Flt. Sgt. J. A. NICHOLSON, R.N.Z.A.F., No. 206 Sqn.
Flt. Sgt. M. I. WEBB, R.A.F.V.R., No. 248 Sqn.
Flt. Sgt. L. W. WOODARD, R.A.F.V.R., No. 605 Sqn.
Flt. Sgt. G. D. GREENWELL, R.A.F.V.R., No. 196 Sqn.
Flt. Sgt. G. E. THOMPSON, R.A.F.V.R., No. 190 Sqn.
Flt. Sgt. J. H. WAUGH, R.C.A.F., No. 420 (R.C.A.F.) Sqn.
Sgt. A. KENYON, R.A.F.V.R., No. 419 (R.C.A.F.) Sqn.
Sgt. S. SCOTT, R.A.F., No. 425 (R.C.A.F.) Sqn.
Flt. Sgt. G. G. H. RODWELL, R.A.F.V.R., No. 166 Sqn.
Flt. Sgt. P. B. ROMBACK, R.A.F.V.R., No. 578 Sqn.
Flt. Sgt. R. SMITH, R.A.F.V.R., No. 97 Sqn.
Flt. Sgt. J. SILBURN, R.A.F.V.R., No. 635 Sqn.
Flt. Sgt. D. THOM, R.A.F.V.R., No 90 Sqn.
Flt. Sgt. T. R. WADE, R.A.F.V.R., No. 101 Sqn.
Flt. Sgt. A. J. WALKER, R.A.F.V.R., No. 156 Sqn.
Flt. Sgt. S. C. WOOLLEY, R.A.F.VR, No. 7 Sqn.
Flt. Sgt. D. YATES, R.A.F.V.R., No. 582 Sqn.
Act. Flt. Sgt. N. J. LOADER, R.A.F.V.R., No. 156 Sqn.
Sgt. F. ADDY, R.A.F.V.R., No 432 (R.C.A.F.) Sqn.
Sgt. C. COX, R.A.F.V.R., No. 405 (R.C.A.F.) Sqn.
Sgt. A. L. CUNNINGHAM, R.A.F.V.R., No. 9 Sqn.
Sgt. C. DEAVES, R.A.F.V.R., No. 428 (R.C.A.F.) Sqn.
Sgt. (now P/O.) A. V. PLUMMER, R.A.F.V.R., No. 432 (R.C.A.F.) Sqn.
Sgt. G. ROBERTS, R.A.F.V.R., No. 7 Sqn.
Sgt J. W. E. SCRACE, R.A.F.V.R., No. 12 Sqn.
Sgt. A. F. SMITH, R.A.F.V.R., No. 578 Sqn.
Sgt. A. R. TYRELL, R.A.F.V.R., No. 166 Sqn.
Flt. Sgt. R. E. HARROP, R.A.A.F., No. 635 Sqn.
Flt. Sgt. (now P/O.) D. J. NICKLEN, R.C.A.F., No. 420 (R.C.A.F.) Sqn.
Flt. Sgt. (now P/O.) J. M. ROSS, R.C.A.F., No. 424 (R.C.A.F.) Sqn.
Flt. Sgt. (now P/O.) A SHEPHERD, R.C.A.F., No. 90 Sqn.
Flt. Sgt. (now P/O.) R. W. SHOPLAND, R.C.A.F., No. 405 (R.C.A.F.) Sqn.
Sgt. K A. HABT, R.C.A.F., No. 405 (R.C.A.F.) Sqn.

S.W. Pacific

THE KING has been graciously pleased to approve the following award with effect from January 23rd, 1945, in recognition of gallantry displayed in flying operations against the enemy in the South-West Pacific area:—

Distinguished Flying Cross

W/O. W. J PORTER, R.N.Z.A.F., No. 3 Sqn.

Army Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallant and distinguished services in North-West Europe:—

Distinguished Flying Cross

Capt. (temp. Maj.) J. F. B. BLATCH, Army Air Corps.
Capt. (temp Maj.) S. C. GRIFFITHS, Army Air Corps.
Capt. (temp Maj.) T. I. J TOLER, Army Air Corps.

Air Force Cross

Lt. (temp. Capt.) E. J. THOMAS, Army Air Corps.

Bar to Distinguished Flying Medal

Staff Sgt. H. N ANDREWS, D.F.M., Army Air Corps.

Distinguished Flying Medal

Sgt. (act. Staff Sgt.) R. G. DOUGLAS, Army Air Corps.
Sgt. (act. Staff Sgt.) S. G. ISAACS, Army Air Corps
Staff Sgt. J. A. RYE, Army Air Corps.
Staff Sgt. C. W. TWIGGS, Army Air Corps.

Roll of Honour

Casualty Communiqué No. 474.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 100 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Sgt. R. Ashworth; F/O. C. Bertenshaw; F/O. K. Bottrill; F/O. S. T. Byer; W/O. E. Cross; Flt. Lt. T. C. Hood; F/O. W. W. Jackson; Act. Sqn. Ldr. D. H. S. Kay, D.F.C.; Sgt. W. C. Tatum; Flt. Lt. N. Taylor, D.F.M.; P/O. F. J. Vance; F/O. L. P. Whipp; F/O. G. B. Whittaker.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. A. E. Jones; P/O. D. L. Wright.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. C. J. Barron; F/O. A. B. Bearcroft; Flt. Sgt. K. A. Beech; Sgt. A. J. Belton; Sgt. G. Blake-Hales; Sgt. H. Bowles; Flt. Sgt. C. R. Boyd; Flt. Sgt. H. Boyes; Flt. Sgt. W. H. Bryant; Sgt. C. Burgess; Act. Flt. Sgt. N. D. Cameron; P/O. R. J. Caseley; Sgt. K. W. Cheshire; Sgt. R. S. Chesters; P/O. R. J. Cook, D.F.M.; Sgt. A. P. Coombe; Sgt. C. C. Corrie; Flt. Sgt. G. T. Cox; Sgt. D. G. Craig; Sgt. O. D. Culverwell, D.F.M.; Sgt. D. J. Ferguson; Sgt. R. A. Forte; Sgt. F. B. Grey; Sgt. R. L. Hands; P/O. S. Heald; Flt. Sgt. W. Jenkins; P/O. G. A. Johnson; F/O. L. C. Keeling; P/O. J. C. Kempsell; Sgt. R. E. Locke; F/O. W. C. J. Lord; Sgt. J. McCurry; Sgt. K. R. Marriott; Flt. Lt. A. T. Martens; F/O. R. L. Mooney, D.F.M.; Sgt. W. V. Murray; Sgt. H. S. Oldfield; Sgt. G. E. Phillips; Sgt. J. Ringwood; Sgt. K. J. Robotham; Sgt. W. L. Pritchard; Sgt. R. F. Smale; Flt. Sgt. G. E. Smith; Flt. Sgt. W. J. Smith; F/O. R. J. T. Stirling; P/O. S. W. H. Taylor; Sgt. H. E. Thompson; Sgt. T. G. Townson; Flt. Sgt. J. M. Turnbull; Sgt. W. R. Tyrie, D.F.M.; Sqn. Ldr. K. F. Vare; Sgt. E. Vine; Sgt. R. S. Western; Sgt. J. A. Wilde; Sgt. A. Woolley.

WOUNDED OR INJURED IN ACTION.—Sgt J. S. Atkinson; W/O. W. W. S. Bond; Sgt. E. W. Knight.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. J. Darlington; Sgt. K. Morrell; Flt. Sgt. R. Phillips; Flt. Sgt. R. A. Pratt; Sgt. W. P. L. Purnell Edwards; Sgt. G. I. Read.

MISSING.—Sgt. H. H. Bawden; Sgt. A. R. Best; Flt. Lt. G. B. Brooker; Act. Flt. Lt. I. H. Bruce; F/O. R. McN. Buist; Flt. Lt. A. W. Campbell; Sgt. J. R. Chambers; Flt. Sgt. S. Cole; F/O. C. N. O. Crawford; Sgt. J. Crosbie; Sgt. S. S. De Lisle; Sgt. R. P. Duncombe; Sgt. H. Dunn; Sgt. A. D Etheridge; Ft. Sgt. T. E. Feaver; Sgt. L. W. Fiest; Sgt. A. H. Frost; Sgt. J. Gerrard; Sgt. A. D. Griffin; Sgt. S. A. Gumbrell; Flt. Sgt. N. Heslop; Sgt. J. Houghton; Sgt. K. B. Howell; Sgt. R. H. Hughes; Sgt. F. H. W. James; Sgt. J. H. P. Jibson; F/O. W. T. E. Legg; P/O. E. Leigh; F/O. P. F. Lewcock; Flt. Sgt. J. McEwan; W/O. P. McKee; Flt. Lt. R. D. W. MacKenzie; W/O. N M. McL. Martin, D.F.C.; P/O. T. D. L. Mason; F/O J. Mayson; Sgt. N. B. Molyneux; Flt. Sgt. P. A. Noel; Sgt. D. D. Pettit; W/O. I. L. Ramsay; Sgt. J. Robinson; F/O. Y. Rolin; Flt. Sgt. E. J. Sharp; Sgt. D. C. R. McN. Shearer; Sgt. J. R. Sunley; W/O. F. H. Swinson; P/O. G. H. Tindall; W/O. H. C. White; Sgt. W. R. Young.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. D. T. Bax; Flt. Sgt. A. G. Harbottle; P/O. W. Jones; Flt. Sgt. F. Mockridge.

KILLED ON ACTIVE SERVICE.—Sgt. J. S. Allan; Flt. Lt. R. J. Beckley; Flt. Sgt. E. Birkby; F/O. R. H. Cornell; Sgt. G. W. Cundick; Sgt. B. G. Davis; Sgt. R. L. Dixon; Sgt. J. J. Donnachie; Flt. Lt. D. Evans, D.F.C.; Sgt. W. B. Ferguson; F/O. W. P. C. Finlayson; Sgt. J. Fletcher; Sgt. R. Gough; Sgt. G. D. Grant; P/O. P. R. V. Jones; Sgt. D. A. Josey; W/O. R. F. Knight; Flt. Sgt. M. H. G. Lane; Sgt. E. W. Leivers; Sgt. H. Lewis; F/O. H. Lewis; F/O. P. McPhillips; Sgt. K. Maxwell; P/O. D. Millatt; W/O. A. J. Novis; Sgt. C. S. Offord; Sgt. W. H. Plunkett; Sgt. D. Pratt; Act. Flt. Lt. D. W. Rimell; Flt. Sgt. J. H. Saunders; Sgt. P. R. Scott; Sgt. R. M. Sinclair; Sgt. D. G. Talbot; Flt. Sgt. D. B. J. P. Watson; Flt. Sgt. A. R. Williamson; Act. Flt. Lt. C. D. Young.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Sgt. A. E. Christison; F/O. N. B. Holdsworth; P/O. G. A. Lovell; Sgt. K. Quiney; F/O. G. L. Robinson; Flt. Lt. A. B. Snelling; A/C.2 A. J. Willn; Sgt. L. J. Williamson; F/O. A. Yates.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. R. P. Richardson; Cpl. C. E. Turvey.

DIED ON ACTIVE SERVICE.—A/C.2 R. C. Bailey; Act. Sqn. Ldr. E. D. Bath; Sgt. T. Carndull; L.A/C. F. A. Castle; Sgt. J. S. Cookson; L.A/C. S. Craven; L.A/C. I. J. Davies; P/O. R. D. Griffiths; L.A/C. H. Gunn; Act. Sqn. Ldr. R. S. De V. Le Masurier, D.F.C.; L.A/C. R. D. Mansell; A/C.2 G. D. Musgrove; L.A/C. H. W. Snowling; Sgt. H. Tatton; Flt. Lt. T. D. Tinsey, D.F.C.; Act. Cpl. W. Waugh; W/O. T. A. Whiteley.

The Crest of No. 169 Sqn. —"Hunt and Destroy."

Women's Auxiliary Air Force

MISSING.—L.A/CW. M. Campbell

Royal Australian Air Force

KILLED IN ACTION.—F/O K. F. Hynes; Flt. Sgt. R. J. Mullins.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. L. O'Brien

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. S. Alexander; P/O. R. C. K. Anderson; Flt. Sgt. S. G. Berry; P/O. A. E Blight; Flt. Sgt. J. A. Buckman; Flt. Sgt. D. J. Cowin; Flt. Sgt. K. N. B. Davies; W/O. R. R. Donaldson; P/O. D. C. Dripps; Flt. Sgt. J. R. Forbes; Flt. Sgt. I. L. Fraser; Flt. Sgt. K. R Fuller; Flt. Sgt. G. G. Gillett, Flt. Sgt. D. O Grant; Act. Flt Lt. G. H. Harvey; Act. Flt. Lt. D. S. P. Howe; Flt. Sgt. J. P. Irwin; Flt. Sgt. W. R. Jager; Flt. Sgt. E. A. Joyce; Flt. Sgt. G. H. Kloske; Flt. Sgt. R H. Matheson; Flt. Sgt. A. Morgan; Flt. Sgt. J. A. McC. Murray; Flt. Sgt. P. F. O'Loghlen; P/O. M. M Patrick; F/O. C. I. Reynolds; Flt. Sgt. W. J. Roche; P/O. W. H. Rose, D.F.C.; Flt. Sgt. L. J. Sheean; P/O. D. B. Snape; P/O. J. Syme; P/O. B. A. Tait; F/O. D. Todhunter; Flt. Sgt. W. G. Ward.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. A. J. Smith

MISSING.—Flt. Sgt. E. P. Austin; Flt Sgt.

NEW GUARD: R.A.F. Regiment gunners protect a Spitfire airstrip in Burma from low-level attack. The gunners are, left to right, Cpl. Law, L.A/C. Cooper, L.A/C. Woods and L.A/C. Ellis.

SERVICE AVIATION

K. W. Bardsley; Act. Sqn. Ldr. N. L. Bourke; P/O. D. K. Caldwell; Flt. Sgt. F. J. Cook; F/O. K. R. Dumas; Flt. Sgt. A. Farmer; W/O. J. W. Langley; P/O. A. C. E. McIntosh; P/O. F. E. Nelder; Flt. Sgt. G. A. Palmer; Flt. Sgt. E. H. Richardson; Flt. Sgt. L. G. Robertson; P/O. N. A. Stevens; Flt. Sgt. D. V. Watson; Flt. Sgt. M. L. Wood.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. H. H. Chapman.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. L. D. Moran.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. G. A. Hebblewhite.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—F/O. H. C. Wills.

Royal Canadian Air Force

KILLED IN ACTION.—W/O. J. E. A. Gauthier; F/O. F. G. Todd.

MISSING.—Flt. Lt. C. S. Aistrop, A.F.C.; Flt. Lt. E. L. Ashbury; F/O. A. Barr; F/O. R. M. Coooper; P/O. J. Earl; F/O. A. J. Horrell; F/O. R. O. Hunter; P/O. N. Joss; P/O. P. C. Lailey; Flt. Sgt. J. W. Lockwood; P/O. J. McCormick; F/O. T. K. Montgomery; F/O. L. P. E. Piche; P/O. E. T. Rivers; Wing Cdr. G. A. Roy, D.F.C.; Flt. Sgt. D. O. Schneider; W/O. R. W. R. Shaw; W/O. J. H. Soper.

KILLED ON ACTIVE SERVICE.—F/O J. D. Beagley; L.A/C. J. D. Beck; F/O. F. A. Bell; Flt. Sgt. W. T. Borrowman; Flt. Lt R. A. Campbell; Sgt. H. H. Cleghorne; Sgt. G. F. Cumming; Sgt. J. Derbyshire; P/O. J. F. Dowding; F/O. W. R. Ewing; F/O. M. L. M. Gillis; F/O. M. J. Hamblin; F/O. C. J. Hogan; F/O. J. A. Johnston; L.A/C. O. F. Larson; P/O. L. W. McChesnie; P/O. D. K. I. MacNicol; Sgt. G. R. McWhirter; F/O. R. D. Matthew; Sgt. L. J. Olmstead; L.A/C. M. Olshansky; Sgt. O. Parsons; Sgt. H. E. Pyche; F/O. K. Reed; Flt. Sgt. E. W. Reid; Sgt. G. Riddoch; Flt. Sgt. D. J. Rodgers; Flt. Sgt. R. Smith; F/O. J. R. Stoneman; P/O. A. L. Sunstrum; L.A/C. J. E. Sykes; Sgt. D. F. Titt; L.A/C. W. R. L. Wabb; F/O. W. D. Wall; P/O. D. McL. W. Ward; Sgt. S. W. Wells; Flt. Sgt. B. L. White; F/O. R. N. Whitley; Sgt. C. G. Whittingstall; Flt. Sgt. A. R. Wilde; Flt. Lt. D. Z. T. Wood; Sgt. C. C. W. Woodford.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Cpl. K. A. Bunt; Sgt. N. A. Gorrie; L.A/C. G. H. A. Leblanc; Cpl. J. D. Marsh; Flt. Sgt. R. S. Walker; L.A/C. R. A. Wallace.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—F/O. A. R. Hall; Sgt. C. C. Stewardson.

DIED ON ACTIVE SERVICE.—P/O. G. A. Simpson; Flt. Lt. R. B. Van Kleek.

Royal New Zealand Air Force

KILLED IN ACTION.—Flt. Sgt. W. H. J. Barnes; Flt. Sgt. C. J. H. Falconer; Flt. Sgt. H. C. Reay.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. A. W. Clark; Flt. Sgt. E. C. Hamblyn; F/O. A. D. Howlett; F/O. R. C. Newcomb; Flt. Sgt. J. Sutherland.

MISSING.—P/O. B. C. Jeffares; F/O. D. A. Sandman; W/O. J. W. Steed.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—W/O. D. J. Edmiston.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. N. C. Burgess; Flt. Sgt. G. Child; Flt. Sgt R. P. Furey; Flt. Sgt. J. M. Stack; Flt. Sgt. P. D. Young.

South African Air Force

MISSING.—Lt. H. L. Harrison; Lt. J. R. Lund; Lt. A. Rots-Henry; Lt. PJ. A. Zinn.

Casualty Communique No. 475

Of the names in this list 100 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. R. A. Cambrook; Act. Sqn. Ldr. D. S. Edwards; Sgt. M. G. Gibson; Sgt. A. P. Goddard; Flt. Sgt. I. D. Goodwin; Sgt. R. Holt; F/O. E. S. Joly; F/O. A. Keith-Thomas; P/O. J. McLean; Flt. Sgt. R. E. E. Manktelow; F/O. L. Sandifer; Flt. Lt. L. E. Tanner; Sgt. M. L. Tansley; Sgt. R. J. Ward.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. D. Drummond; F/O. J. D. Miller; Flt. Sgt. C. E. Pearson; Sgt. A. T. Sinclair; Sgt. A. Trivett.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. J. Alexander; Sgt. K. C. Bartlett; Sgt. J. E. Beattie; Sgt. J. K. Boothroyd; Sgt. A. J. Bristow; F/O. J. W. Bryan; Sgt. K. A. J. Campbell; Sgt. R. E. W. Cheeseman; P/O. R. J. Child; P/O. G. Clarke; Sgt. R. C. Crockett; Flt. Sgt. G. W. Crowe; Act. Sqn. Ldr. A. S. Cussens; Sgt. A. H. Daines; Sgt. E. Draper; F/O. W. A. Eagles; Flt. Sgt. K. McL Fairbairn; Flt. Sgt. P. S. A. Fielding; Sgt. J. H. Flack; Flt. Sgt. K. W. Flowers; Sgt. C. A. Giffard; Sgt. K. E. Gilson; Sgt. F. Habbersnaw; Sgt. S. G. Hubbard; Sgt. R. Jeffreys; Sgt. R. W. Jeffs; Sgt. R. S. Johnstone; P/O. F. Law; Sgt. D. S. Lockett; F/O. A. P. S. Milligan; Flt. Sgt. H. S. Murton; Sgt. R. Nelson; Flt. Sgt. E. C. Nicholls; Sgt. W. R. Owen; Sgt. C. D. Panes; Sgt. H. W. Parsons; Sgt. T. F. Quine; F/O. R. A. Quinney; Sgt. J. C. Smith; F/O. K. J. Strong; Flt. Sgt. D. R. Taylor; Sgt. A. Thompson; Sgt. N. A. Verner; Act. Flt. Lt. W. H. L. S. Way; Sgt. W R. Weston; Sgt. T. N. Whelan; Sgt. F. Wooldridge; Sgt. W. G. Yorke; Sgt. R. W. Young.

WOUNDED OR INJURED IN ACTION.—Sgt. P. F. Bolderstone; Sgt. C. Dent; Flt. Lt. B. P. Legge; Sgt R. Ralston.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Flt. Sgt. R. V. Hall; F/O. R. Hartley.

MISSING, BELIEVED KILLED IN ACTION.—F/O. R. Brown; Sgt. D. Clark; Sgt. K. D. Daker; Act. F/O. R. Davies; Sgt. R. Eayres; Sgt. P. H. Edwards; F/O. H. T. Ford; Sgt. P. H. F. Hughes; Flt. Sgt. E. Newman; Sgt. L. Phillips; Sgt. E. M. P. Rice; Flt. Sgt. C. D. Richards; F/O G. S. Richardson; Flt. Lt. J. B. Shillitoe; Sgt. S. D. Starbuck; Sgt. H. V. Ward.

MISSING.—W/O. R. G. Abraham; Flt. Sgt. D. Adams; P/O. J. G. Allen; Sgt. H. Austin; Sgt. M. Austin; Sgt. R. Bailey; Sgt. A. G. Beesley; W/O. R. W. F. Bodley; Sgt. J. E. Boswell; Sgt. R. C. Bowden; Flt. Sgt. R. F. J. Bright; Flt. Sgt. P. L. Brooker; Sgt. E Brunskill; Sgt. A G. Butcher; Sgt. E. Campbell; P/O. S. Campbell; P/O. J. A. C. Clarke; Flt. Sgt. F. L. J. Colbourn; Sgt. R. C. Coley; Sgt. W. F. Cowan; Sgt. G. Coyle; Sgt. C. G. N. Darlow; Act. F/O. T. C. Dawson; F/O. J. A. Dean; Flt. Lt. F. H. Dell; Sgt. T. A. Dennett; Flt. Sgt. A. Easton; Sgt. G. F. Ellis; W/O. W. Entwistle; Sgt. F. Evans; Sgt. T. W. Farmer; Sgt. G. A. Fergus; Sgt. P. S. Foster; Sgt. H. Foy; Sgt. J. D. Garland; Sgt. R. Garrad; Flt. Sgt. W. R. Garrison; Sgt. E. Gedling; Sgt. D R. Gilfillan; Sgt. H. Glasper; Sgt. J. Haley; Sgt. R. Hamilton; F/O. A. Hanson; Sgt. L. Harris; Sgt. M. R. F. Harris; Sgt. D. Hill; Flt. Sgt. T. E. Hughes; Sgt. C. Johnson; P/O. R. W. Johnson; Sgt. F. C. Jones; Sgt. L. Kendrew; F/O. F. M. Kennedy, D.F.M.; Flt. Sgt. E. J. Kiely; P/O. C. F. Kirby; Sgt. J. E. Knott; Sgt. J. Lambert; Sgt. C. Leeming; F/O. A. Linton; Sgt. E. Lockey; Sgt. S. J. Lovett; Sgt. A. E. Lukeman; Act. F/O. L. J. T. McCarthy; Sgt A. B. McGlynn; F/O. A. G. McLean; Sgt. J. Morley; Sgt. J. Munday; Sgt. A. G. Murray; Sgt. T. Myers; Sgt. K. K. Nagalingan; F/O. R. A. Naiff; Sgt K. W. Nettleton; Sgt. F. W. Niblett; Flt Lt G. E. Nicholls; Sgt. S. H. Parker; Flt. Sgt. F. D. T. Phillips; P/O. R. T. Pither; Sgt. G. S. Pridden; Sgt. W. Raine; Sgt. D. P. Richmond; Flt. Sgt. E. F. Rogers; Act. F/O. H. A. S. Russell; Sgt. K. R. Salton; Flt. Lt. L. Shackman; Act. F/O. G. K. Shaw; Flt. Sgt. J. S. Shearing; Sgt. J. D. Shilock; Flt. Sgt. A. P. Soper; Sgt. J. E. Speed; Sgt. G. J. Spillman; Sgt. A. Stewart; Sgt. W. J. Stockwell; Sgt. H. A. Sumner; Flt. Lt. A. W. Thomas; W/O. D. Thompson; Sgt. R. Thompson; W/O. C. E. Towill; Sgt. J. Turner; Flt. Sgt. R. F. Veness; Sgt. R Wills

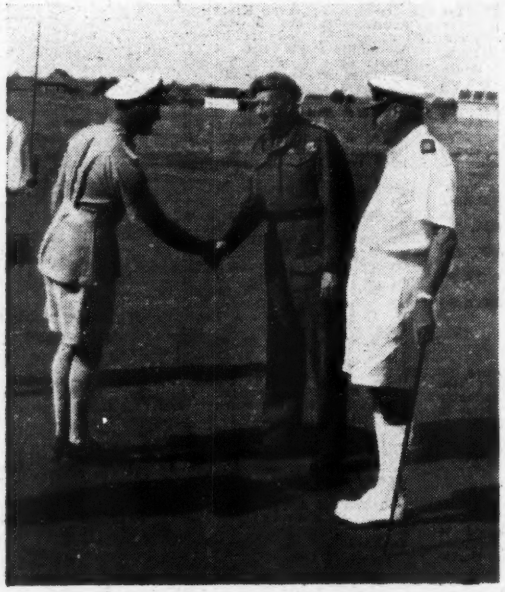
KILLED ON ACTIVE SERVICE.—Flt Sgt. J. Banfield; Flt. Sgt. L. G. Bird; Sgt. S. M. Best; P/O. G. R. B. Crowley; Sgt. J. J. Davies; F/O. J. H. Dennis; Sgt. F. Drinkwater; Flt. Sgt. G. A. Goodinson; A/C.1 E. M. Grant; Sgt. J. E. Hamilton; Sgt. K. H. Marshall; Flt. Sgt. W. S. Newman; F/O. M. E. Sauzier; Sgt. J. C. Shannon; L.A/C. E. R. Stone.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. K. E. Brookes; Act. Wing Cdr. N. A. Burt; A/C.1 H. Butterworth; P/O. A. A. Chappell; Sgt. L. S. Dart; L.A/C. E. S. Evans; Sgt. C. Hobden; P/O. W. L. Lund; Flt. Sgt. D. A. B. Newby; L.A/C. W. J. Palmer; Flt. Lt. J. C. Perkins; Sgt. J. P. Waters; Act. Flt. Lt. J. C. W. Weller, D.F.C.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. B. E. Lomas; W/O. R. McKay; Flt Lt. N. Smart.

DIED ON ACTIVE SERVICE.—L.A/C. S. A. Cooper; Sgt. A. G. Edwards; Act. Flt. Lt. F. Garlick; Sgt. J. H. Gregory; Sgt. W. J. Hetherington; L.A/C. P. A. Jee; L.A/C. G. Leadbitter; Sgt. L. Linegar; F/O. E. J. Neild; Flt. Lt. M. H. Pinches, D.F.C.; L.A/C. C. E. Portlock; L.A/C. J. R. Ryder.

PREVIOUSLY REPORTED MISSING, NOW PRISONER OF WAR.—Flt. Sgt. J. Woodward.



General Auchinleck recently visited a Fleet Air Arm station in India. He is seen here with Vice-Admiral Moody, Flag Officer (Air), East Indies, and the Commander of the Station, Capt. Malleson.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. S. M. Laman.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. L. D. Anderson; Flt. Sgt. L. R. Carius; Flt. Sgt. A. F. Drummond; P/O. L. S. Fairclough; F/O. G. B. Hoddle; P/O. K. H. W. Kirkland; Flt. Sgt. A. M. Legrand; Flt. Sgt. J. G. McLean; W/O. R. de B. Morrison; F/O. R. Wheatley.

WOUNDED OR INJURED IN ACTION.—P/O. A. J. Cockerill.

MISSING, BELIEVED KILLED IN ACTION.—P/O. J. F. Loughman; Flt. Sgt. C. G. Steele.

MISSING.—Act. F/O. R. W. Brown; Flt. Sgt. L. W. Calder; Flt. Sgt. R. Coward; P/O. A. F. Emery; Flt. Sgt. E. C. Fitzgerald; F/O. M. A. Flory; F/O. J. R. Frees; W/O. J. R. Gibson; F/O. G. H. Hammond; Flt. Sgt. G. A. Henry; Flt. Sgt. I. Hunter; Flt. Sgt. L. R. Johnston; Flt. Sgt. J. E. J. Kelly; Flt. Sgt. R. G. Kingsley; Flt. Sgt. A. B. Llewellyn; F/O. D. W. MacLean; W/O. J. F. Maple; Flt. Sgt. M. Marshall; W/O. J. Philip; Act. F/O. E. F. Reid; Flt. Sgt. K. H Rowley; Flt. Sgt. R. H. Royes; Flt. Sgt. W. M. Schafer; Flt. Sgt. A. R. Telford; P/O. D. J. White.

KILLED ON ACTIVE SERVICE.—F/O. A. V. Browne.

DIED ON ACTIVE SERVICE.—Flt. Sgt. G. J. Suter.

Royal Canadian Air Force

KILLED IN ACTION.—Flt. Sgt. L. D. Bennett; Flt. Sgt. E. W. Bock; F/O. S. D. Gaudin; F/O. L. A. Hannah; Flt Sgt. C. H. Males; P/O. J. Zareikin.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. R. E. Clark; Act. Flt. Lt. F. Halliday; F/O. R. R. MacGregor; Sgt. G. L. MacKay; F/O. G. E. McTaggart.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. P. Armstrong; F/O. J. C. Austin; F/O. G. C. Bailey; Flt. Sgt. P. J. Barske; Flt. Sgt. D. Bernard; W/O. E. C. Brunet; Flt. Sgt. C. E. Byers; F/O. G. H Coles; Flt. Sgt. W. E. Dickson; F/O. N. E. Hanna; P/O. A. Harrison; Flt. Sgt. J. Jensky; W/O. L. N. L. Kerr; F/O. P. J. A. Mageau; F/O. C. M. Mair; Flt. Sgt. C. C. Maw; F/O. W. A Mitchell; W/O. W. J. M. Nickerson; P/O. O. A. O'Leary; F/O. R. H. Orr; Flt. Sgt. S. J. Ouellette; F/O. D. E. Pushor; F/O. R. B. Richard; F/O. C. R. Sandes; P/O. B. H. W. Stevens; W/O. D. S. Storey; Flt. Sgt. W. Sweeney; Flt. Sgt. B. H. Varey; W/O. C. N. D. Wright.

WOUNDED OR INJURED IN ACTION.—F/O. L. W. Sitlington; Flt. Sgt. R. A. Toane; F/O. J. M. C. Wallace.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—F/O. C. J. Prawdzik; Sgt. M. Washook; F/O. W. F. Winning.

MISSING.—P/O. J. W. Brown; F/O. L. J. Dick; F/O. T. F. Kimsler.

DIED ON ACTIVE SERVICE.—L.A/C. S. Campbell; L.A/C. R. J. Caverly.

Royal New Zealand Air Force

KILLED IN ACTION.—Flt. Lt. A. G. St. John.

MISSING.—F/O. I. D. Graham; F/O. J. D. K. McFarlane; Act. Flt. Lt. J. Ward.

KILLED ON ACTIVE SERVICE.—Flt. Sgt. A. F. Hampshire.

WOUNDED OR INJURED ON ACTIVE SERVICE.—W/O. J. McK. Campbell.

South African Air Force

KILLED IN ACTION.—Lt. H. M. Fisher.

MISSING.—Lt. E. Colbert; Lt. D. C. Cullingworth; 2/Lt G. C. Dicks; Lt. C. S. S. Franklin; Lt. J. A. Lithgow, D.F.C.; Lt. K. J. McLeod; Lt. K. B. MacWilliam; Lt. C. P. Nel; Lt. H. K. Packman; Lt. G. Ray-Howlett; Capt. J. V. Rockford; Lt. C. B. Vorster.

KILLED ON ACTIVE SERVICE.—Lt. W. D. Bell.